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# AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

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## CONTENTS.

PAGE

American Machine-Tool Trade in England ..... 987
The Cost of Air Compression. By Frank Richards..... 987
Some Points of English Engineering Practice—Prices of Boilers and Engines—Use of Economizers..... 988
Molding Large Pulleys. By L. C. Jewett ..... 989
Machinery Exports..... 990
Accurate Surfaces on Wood—Boring Square Holes—An Elevator Used for Weighing Machinery—A Box Tool—Hollow Mills. By S. T. Freeland ..... 990
Fifteen-Inch Slotter..... 992
A New Locking Nut..... 993
Boring and Turning Mill with Extra Head ..... 993
Crosshead Wrist-Turning Trap. From the De La Vergne Shops. By John Randol ..... 993
The Mechanical Engineer..... 995
Chain-Link Drilling Machine..... 997
Fallacies in Boiler Practice. By W. H. Booth..... 997
Electrical Machinery: Ball Step Bearing and Magnetic Brake of the Sprague-Pratt Electric Elevator.... Electric Locomotives on the Elevated Railroad..... 998
Letters from Practical Men: Hardening in Gas Furnaces. By Geo. F. Champney....Running Engine Without Cylinder Oil—Piston-Rod Fastenings. By W. E. Crane.... Rig for Boring Taper Hole in Crank. By Jas. T. Fink....Home-Made Rotary Shears. By J. Landsing....Home-Made Shop Tools. By Tecumseh Swift....Backing Off Reamers. By Francis W. Clough.... Shade Lines in Working Drawings. By Fidei Defensor.....1000-1003
Compressed-Air Surface Cars in New York .....1003
Citizenship and Technical Education..1004
The Machinery Exhibit at the American Institute Fair.....1005
The Indiana in a Heavy Sea.....1005
The Mechanical Engineer and the Future Development of Rapid Transit .....1006
Questions and Answers.....1007
The Board of Visitors' Report on the Naval Academy.....1007
Drill Jigs in England.....1008
Literary Notes.....1008
Commercial Review.....1008

**Index to Articles Advertised, Pages 10 to 13.**
**Index to Advertisers, Page 9.**

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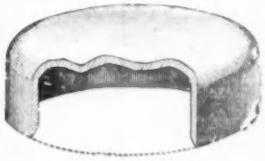
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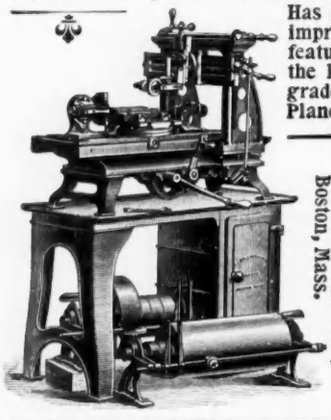

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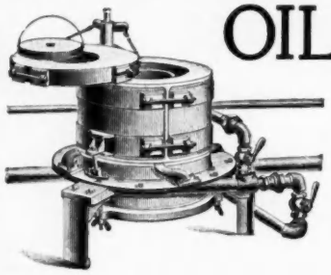

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# Index to Advertisers.


| | PAGE |
|---|---|
| Abbott, Wheelock & Co. | 13 |
| Acme Machinery Co. | 14 |
| Adt & Son, John | 6 |
| Albro-Clem Elevator Co. | 6 |
| Almond, T. R. | 8 |
| American Gas Furnace Co. | 2 |
| Ames Iron Works | 46 |
| Arcade File Works | 14 |
| Armstrong Bros. Tool Co. | 48 |
| Armstrong Mfg. Co. | 46 |
| Aurora Tool Works | 6 |
| Backus Water Motor Co. | 46 |
| Bacon, L. Seward | 5 |
| Baird & Co., Henry Carey | 41 |
| Ball-Bearing Co., The | 13 |
| Barker & Co., William | 8 |
| Barnes Co., W. F. & John | 13 |
| Bates, Henry H. | 5 |
| Baush & Harris Machine Tool Co. | 47 |
| Becher, James A. | 13 |
| Besly & Co., Chas. H | 41 |
| Betts Machine Co. | 40 |
| Bethlehem Foundry and Machine Co. | 13 |
| Bickford Drill and Tool Co. | 43 |
| Bickford, H. | 48 |
| Bilgram, Hugo | 13 |
| Blaisdell & Co., P. | 38 |
| Bliss Co., E. W. | 9 |
| Boston Gear Works | 46 |
| Box 62 | 5 |
| Bradford Mill Co., The | 13 |
| Bremer Machine Co., Godfrey J. | 6 |
| Brown & Sharpe Mfg. Co. | 48 |
| Buffalo Forge Co. | 47 |
| Builders Iron Foundry | 2 |
| Bullard Machine Tool Co. | 10 |
| Central Packing Works | 4 |
| Cincinnati Milling Machine Co. | 41 |
| Cleveland Machine Screw Co. | 45 |
| Cleveland Twist Drill Co. | 43 |
| Clough, R. M | 38 |
| Coburn Trolley Track Mfg. Co., The | 6 |
| Coffin & Leighton | 41 |
| Columbia University | 38 |
| Compressed Air | 43 |
| Conover Mfg. Co. | 41 |
| Crescent Steel Co. | 43 |
| Crocker-Wheeler Electric Co. | 4 |
| Cumberland Iron & Steel Shafting Co. | 5 |
| Curtis & Curtis | 38 |
| Cushman Chuck Co. | 3 |
| Daimler Motor Co. | 4 |
| Dallett & Co., Thos. H. | 4 |
| Davis & Egan Mach. Tool Co | 45 |
| Dawson & Goodwin | 45 |
| Deane Steam Pump Co. | 14 |
| Detrick & Harvey Machine Co. | 47 |
| Diamond Machine Co. | 41 |
| Dietz, Schumacher & Boye | 47 |
| Dixon Crucible Co., Joseph | 45 |
| Dwight Slate Machine Co. | 2 |
| Dyer & Driscoll | 40 |
| Elliott Chemical Works | 4 |
| Erlandsen, J. | 6 |
| Evans Friction Cone Co | 41 |
| Fay & Co., J. A. | 3 |
| Ferracute Machine Co. | 6 |
| Fifield Tool Co. | 48 |
| Fitchburg Machine Works | 43 |
| Flather & Co. | 47 |
| Forbes & Co., W. D. | 8 |
| Frick Co., The | 46 |
| Garvin Machine Co., The | 8 |
| General Electric Co. | 3 |
| Goodyear, S. W. | 4 |
| Gould & Eberhardt | 14 |
| Grant Gear Works | 14 |
| Gray Co., G. A. | 14 |
| Hamilton Machine Tool Co. | 2 |
| Hampden Corundum Wheel Co. | 3 |
| Hardinge Bros. | 3 |
| Harrington & King Perforating Co. | 48 |
| Harrington, Son & Co., E. | 41 |
| Hartford Steam Boiler and Ins. Co. | 38 |
| Hendey Machine Co | 39 |
| Henley & Co., N. W. | 38 |
| Hill, Clarke & Co. | 14 |
| Hoggson & Pettis Mfg. Co. | 3 |
| Horton & Son Co., E. | 3 |
| Hurlbut-Rogers Machine Co | 47 |
| Hyatt Roller Bearing Co. | 2 |
| International Correspondence Schools | 6 |
| Jenkins Bros. | 40 |
| Johns Mfg. Co., H. W. | 47 |
| Jones & Co., B. M. | 2 |
| Jones & Lamson Machine Co. | 14 and 48 |
| Kelly & Jones Co. | 46 |
| Keuffel & Esser Co. | 12 |
| Keystone Engine and Machine Works | 46 |
| Landis Bros. | 2 |
| Le Blond, R. K. | 38 |
| LeCount, Wm. G | 3 |
| Lodge & Shipley Machine Tool Co | 5 |
| Long & Allstatter Co. | 3 |
| Luscomb Machine Co., F. W | 2 |
| Maris Bros. | 47 |
| McCabe, J. J. | 8 |
| McFadden Co. | 13 |
| Mewer Tool Co. | 8 |
| Miner & Peck Mfg. Co. | 47 |
| Monighan Machine Works | 8 |
| Montgomery & Co | 38 |
| Morse Twist Drill & Machine Co. | 4 |
| Mossberg & Granville Mfg. Co. | 41 |
| National Chuck Co. | 3 |
| National Machinery Co | 6 |
| National Pipe Bending Co. | 43 |
| Newark Machine Tool Co. | 5 |
| New Doty Mfg. Co. | 6 |
| New Haven Mfg. Co. | 11 |
| New Process Raw Hide Co. | 9 |
| Newton Machine Tool Works | 12 |
| Nicholson File Co. | 14 |
| Niles Tool Works Co. | 14 |
| Niles Tool Works Co., N. Y. Branch | 8 |
| Norton Emery Wheel Co. | 40 |
| Oneida Mfg. Chuck Co. | 3 |
| Ott, Mergenthaler & Co | 8 |
| Otto Gas Engine Works | 46 |
| Pancoast Ventilator Co | 3 |
| Patterson, Gottfried & Hunter | 6 |
| Pedrick & Ayer Co | 48 |
| Penberthy Injector Co. | 8 |
| Philadelphia Book Co. | 11 |
| Pierce Engine Co. | 46 |
| Pratt & Whitney Co. | 40 |
| Pratt Chuck Co. | 3 |
| Prentiss Tool & Supply Co. | 5 |
| Prouty Co., The | 46 |
| Pryibil, P. | 12 |
| Q. and C. Co. | 43 |
| Rand Drill Co. | 41 |
| Ransom, Perry | 4 |
| Reece, Edw. J. | 8 |
| Reed Co., F. E. | 41 |
| Roots, P. H. & F. M. | 47 |
| Saunders' Sons, D. | 4 |
| Sawyer Tool Co | 8 |
| Sebastian Lathe Co. | 40 |
| Sellers & Co., Inc., Wm. | 14 |
| Seneca Falls Mfg. Co. | 40 |
| Shriver & Co., T. | 43 |
| Sibley & Ware | 6 |
| Skinner Chuck Co. | 3 |
| Slocomb & Co., J. T. | 11 |
| "Specialty" | 13 |
| Springfield Gas Engine Co., The | 46 |
| Standard Tool Co. | 14 |
| Stark, John | 43 |
| Stiles & Fladd Press Co., The | 38 |
| Sterling Emery Wheel Mfg. Co. | 41 |
| Stover Novelty Works | 45 |
| Strelinger & Co., Chas. A. | 12 |
| Sturtevant Co., B. F. | 47 |
| Stuart's Foundry & Machine Works, R. J. | 48 |
| Taunton Locomotive Mfg. Co. | 43 |
| Timolat, J. G. | 2 |
| Toledo Machine & Tool Co. | 2 |
| Toomey, Frank | 8 |
| Torrington Mfg. Co. | 4 |
| Trenton Iron Co. | 45 |
| Trump Bros. Machine Co. | 13 |
| Vitrified Wheel Co. | 11 |
| Warner & Swasey | 48 |
| Waterbury-Farrel F'dry & Mach. Co. | 47 |
| Waterbury Machine Co., The | 3 |
| Watson-Stillman Co., The | 1 |
| Webster Mfg. Co. | 38 |
| Webster & Perks Tool Co. | 41 |
| Wedderburn & Co., John | 48 |
| Wells Bros. & Co. | 2 |
| Weston Engine Co. | 46 |
| Wetherill Machine Co., James P. | 13 |
| Whitcomb Mfg. Co. | 38 |
| Whiton Machine Co., D. E. | 3 |
| Wiley & Sons, John | 40 |
| Wiley & Russell Mfg. Co. | 40 |
| Wilkinson & Co., A. J. | 2 |
| Wilkinson Co., The | 38 |
| Wilson Laundry Machinery Co. | 45 |
| Wilson, W. A. | 43 |
| Wolverine Motor Works | 46 |
| Woodward & Rogers | 45 |
| Worcester Machine Screw Co. | 47 |
| Wyke & Co., J. | 11 |
| Wyman & Gordon | 48 |



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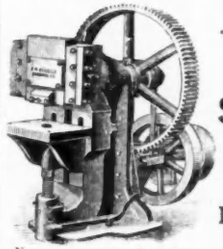

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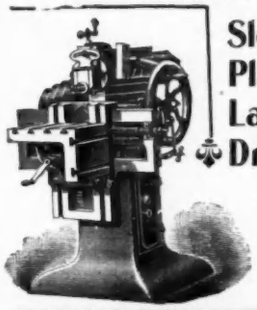
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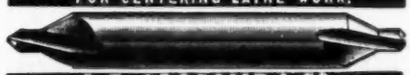
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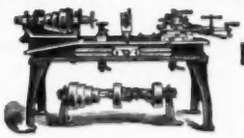
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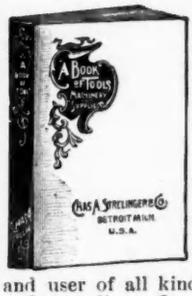


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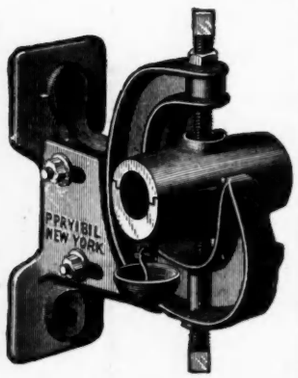


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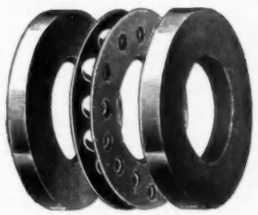

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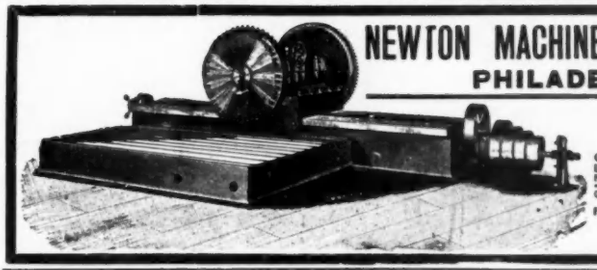

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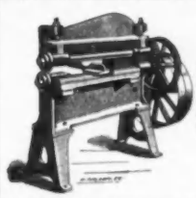

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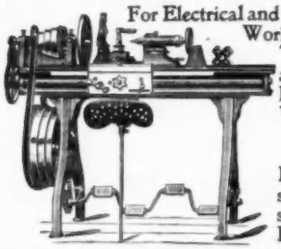

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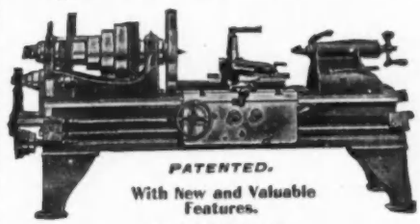

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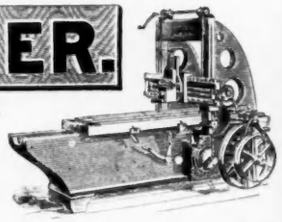

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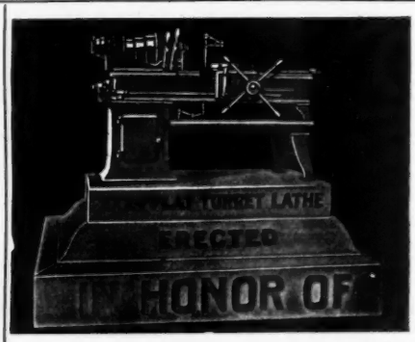


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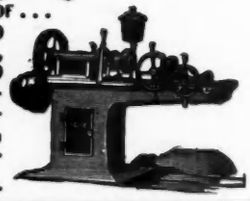

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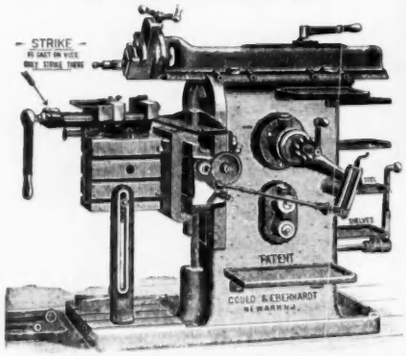


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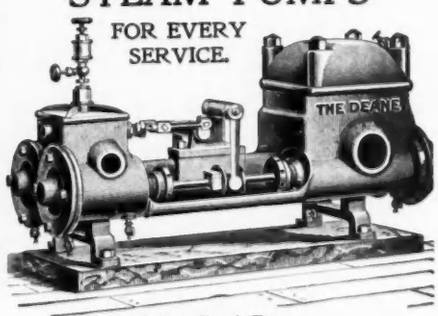


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VOLUME 19. NEW YORK, THURSDAY, OCTOBER 22, 1896. NUMBER 43.

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## American Machine-Tool Trade in England.

We received a call a few days ago from Mr. Charles Churchill, of London, England, and in conversation learned some interesting things regarding the business of introducing American machine and other tools in England, in which business Mr. Churchill has been engaged for the past thirty-one years.

In the first place, as showing the very large proportions to which this business has grown, it may be said that for the seven years previous to September, 1895, the business of Charles Churchill & Co., which is exclusively in American machinery and tools, had increased at the rate of about fifteen to twenty per cent. per annum; but during the year ending September 1, 1896, it increased much more rapidly, and for that year amounted to £110,000 sterling, or, roughly, $550,000. This large increase in volume of business is largely attributed to the growth of the cycle industry over there, our American machine tools being in high favor for that class of work especially, though they are, of course, making rapid headway in other lines. In one case fifty automatic screw machines by the Cleveland Machine Screw Company, were ordered in one lot, and to go into a single plant; and whereas in former years the trade consisted mostly of orders for single machines or at most a very few machines in any one shop, it now often takes the form of complete equipments for the production of a certain machine or article. During the past year business has been so very good with them that they have been under no necessity of soliciting orders, but people have for the most part come into the store to know how soon certain machines could be delivered; and at the time of Mr. Churchill's departure from London, about three weeks ago, there were $150,000 worth of unfilled orders upon their books.

Mr. Churchill describes the method of English mechanics in adopting these tools as being quite conservative and careful, the large sales at present being by reason of the former smaller sales of machines, which machines can now be seen in actual operation in their own shops. Taking the case of the automatic screw machine referred to, for instance, he stated that Mr. John Grant and himself went about in England, about two years ago, and made every effort to get an order for at least one sample machine. They could not at that time secure a single order, people seeming to be inclined to doubt the performance of the machine, and skeptical as to its successful working. Finally, however, after some months had elapsed, two sample machines were ordered, with the statement that at the same time two sample machines made in Germany were to be tried in the same establishment, and future orders would depend upon the results of the trials. Afterwards, twenty or thirty of the American machines were put into the same shop.

At the coming Stanley Cycle Show, Mr. Churchill's concern will have a space 48 x 20 feet, in which American machinery will be shown in actual operation, making parts of bicycles, and they will not merely be operated occasionally, but will be kept in operation, the same as has become the custom with machine tools in our later exhibitions here.

Mr. Churchill says he has encountered very little disposition or inclination to copy American machine designs. There has been relatively very little of this in England, and he thinks this may be due not only to the Englishman's inclination to have and to embody his own ideas in machine construction, but also to the fact that the prices at which American machine tools are sold in that country discourage attempts to compete with the same machines, since it is readily seen that in order to produce similar machines at the same price a similar plant must usually be put down for manufacturing them, and with little hope of producing them at the same or lower cost.

A curious circumstance, for instance, is that for over thirty years Mr. Churchill has been selling in England all sorts of drill and lathe chucks of American manufacture, his average sales of these being from five to eight hundred per month, and yet, so far as he knows, there is not a single chuck-maker in England.

American steel balls are also making headway, and already this year orders for from fifteen to eighteen million American balls have been placed there.

It is expected that over two hundred Cleveland Machine Screw Company's automatic screw machines will be put in over there this year, and another American product that seems to meet with a very favorable reception is the gas furnaces of the American Gas Furnace Company, large numbers of which have been and are being sold there.

▲ ▲ ▲

## The Cost of Air Compression.

BY FRANK RICHARDS.

It seems to be quite desirable all around to come to some better understanding as to the actual cost of compressing air for industrial purposes, and the present seems to offer a good opportunity for me to lend a helping hand in this direction. I am rather under some obligation to do this, as I find that what I have said upon this subject has received an application that I had not contemplated.

Mr. George A. True, in an interesting and instructive paper upon "Compressed Air as a Hoisting Power in the Foundry," recently read before the Western Foundrymen's Association, says: "Mr. Richards asserts that compressed air costs about five cents per 1,000 cubic feet of free air. This is the basis usually taken in making estimates, and at first thought it seems to be very cheap, but with a modern four-stage compressor the cost will be much less; in fact, in some cases it is difficult to see how the cost per 1,000 cubic feet of free air can reach four cents, including depreciation, repairs, oil, fuel, interest and miscellaneous items."

The use that is made of my name as above is not quite correct, as the figure quoted as used by me applied only to certain clearly stated conditions, and covered much more than the simple compression of the air. In some papers which have appeared in the "American Machinist" under the general title, "The Uses and Advantages of a Public Supply of Compressed Air," it was assumed that a company could establish a plant in a large city, laying pipes through the streets, maintaining everywhere a constant air pressure of 100 pounds, and delivering the air to customers wherever it was wanted, metering it and collecting for it just as is now done with gas, charging for the air at the rate of five cents for 1,000

cubic feet of free air, and that the company would be able to realize a handsome profit upon the investment involved in the installation and maintenance of such a system. In this scheme there would, of course, be much more involved than the cost of the air compression, so that it is a mistake to quote the figures used in this connection as representing the actual cost of air compression, and the circulation of the figures without the accompanying conditions cannot fail to convey an incorrect impression.

In my little book, "Compressed Air," a table is given of the actual power required to compress, either adiabatically or isothermally, one cubic foot of free air per minute to any given pressure from 5 to 100 pounds, and from this table it would be quite easy to get an idea of the cost of the compression. Referring to this table, we will find that the theoretical power cost for compressing one cubic foot of free air per minute to 100 pounds gage pressure is 0.13121 horse-power for isothermal compression, and 0.18153 horse-power for adiabatic compression; the former representing the ideally economical and absolutely cheapest compression even theoretically attainable, and the latter representing the most costly mode of compression possible. The power cost of adiabatic compression to 100 pounds gage pressure is 38 per cent. greater than for isothermal compression to the same pressure, or, inversely, perfect isothermal compression will cost 28 per cent. less than perfectly adiabatic compression. For compressing free air to 75 pounds gage pressure, which is the pressure most commonly employed for general work, the power cost for one cubic foot of free air per minute is 0.11629 horse-power for isothermal compression, and 0.15373 for adiabatic compression; the latter being 132 per cent. of the former, and the former 75 per cent. of the latter. As the worst compressor does not come within one or two per cent. of perfectly adiabatic compression, while the best compressor certainly does not come within 5 per cent., and probably does not come within 10 per cent. of perfectly isothermal compression, we have a pretty good idea of the actual saving that can be effected by compound compression when compressing to the common working pressures of 75 to 100 pounds to the inch. Mr. True, in the quotation above, speaks of "the modern four-stage compressor," which is, of course, an absurdity when speaking of the pressures that we are considering. No one that I know of has attempted more than two-stage compression for pressures below 100 pounds.

As the adiabatic compression represents the most costly mode of compression possible, so far as the air itself is concerned, whatever the power cost may rise above that will be due to the friction of the apparatus employed, and not to the condition of the air during compression. With the means of cooling the air during the compression, or at a stage between two partial compressions, that are now quite commonly employed in the best compressors, it is possible to save more by the cooling than will equal the friction cost, so that the figures given for adiabatic compression may be assumed to cover all friction losses, and to cover the total cost of compression. In some of the best compound steam-actuated air compressors the friction losses have been shown to scarcely exceed five per cent., while the reduction of the mean effective resistance for the compression by cooling or intercooling has been shown to be more than ten per cent. below that of adiabatic compression, so that the adoption of the latter for the full power cost of compression is more than warranted by the facts.

One foot of free air per minute compressed to 100 pounds, costing 0.18153 horse-power, 1,000 cubic feet will cost 181.53 horse-power, and 1,000 cubic feet per minute will be 600,000 cubic feet per day of 10 hours. A continuous use of 181.53 horse-power for 10 hours will be 1,815.3 horse-power hours, as the power cost of compressing the 600,000 cubic feet of free air. At 2 pounds of coal per horse-power per hour the coal consumption will be $1,815.3 \times 2 = 3,630.6$ pounds, which at $4 per ton would be $7.26, and $7.26 \div 600 = \$0.0121$ per thousand cubic feet of free air. As this is the coal cost alone, we may double this sum to cover all other expenses, and we then have, say, 2½ cents as the cost of compression to 100 pounds by compressors of large capacity and approaching the best in steam economy.

The common steam-actuated air compressors in general use, no matter of whose make, using steam without compounding and without condensing, and generally not even taking the best advantage of the steam expansion, running also at various speeds and pressures, will consume considerably above 4 pounds of coal per horse-power hour, so that for small and isolated air plants we may double the cost of the compression as arrived at above, and I may safely say, even if I have not said it before, that 5 cents per 1,000 cubic feet of free air compressed to 100 pounds gage pressure is not more than the actual ultimate cost of it.

▲ ▲ ▲

## Some Points of English Engineering Practice—Prices of Boilers and Engines—Use of Economizers.

Mr. Geo. I. Rockwood, of Worcester, Mass., arrived home on the 6th inst. from a three months' trip to England, where he went supposing he was to design some engines on his well-known system of compounding, involving two cylinders with much greater ratio of diameter than are commonly employed in two-cylinder engines. He found, however, on arrival in England that the engines to which these cylinders were to be applied were at work in India, one of them having been installed twenty years ago and the other nine years ago; both engines, however, being precisely alike; which he considered to be one of the points illustrating the difference between English engineering practice and ours, as it would probably be impossible to find in this country two engines precisely alike and differing so much in age. The engines were three-cylinder machines, working with steam at 90 pounds initial pressure, and it was decided, under Mr. Rockwood's advice, to replace the cylinders with two, designed on his system, and to use steam at considerably higher pressure.

Mr. Rockwood had some opportunities of investigating some things connected with English practice which had previously puzzled him somewhat, and among them was the use of economizers in connection with boilers. He says the use of such economizers there is very common, and he thinks it is good practice under their conditions, but that, strange to say, it is generally not good practice in this country under our conditions, and he believes economizers will not obtain any extended foothold here. The difference in practice between the two countries, leading to this conclusion on his part, is in the matter of the proportion of heating surface to grate surface in boilers. He states that it is common practice there, in building their "Lancashire" boilers, to so proportion heating surface that the gases are discharged from the boiler at a temperature of say, 1,000 degrees Fahr., and as, of course, this amount of heat cannot be thrown away, it is taken out from the gases by passing them through economizers, which it pays to put in there, simply because the added heating surface which would be required in the boilers themselves would be about six times as expensive as the economizers are, and they can therefore afford to put up with the inconvenience, cost of repairs, etc., incident to the use of economizers.

In American boiler practice, with much more liberal allowance of heating surface in proportion to grate surface, and with gases discharged at considerably lower temperatures (from 400 to 500 degrees Fahr.), economizers would not pay, and the added heating surface necessary to procure this reduction of temperature in American boilers does not cost nearly so much as in the case of the English "Lancashire" boiler.

Some idea of the difference in cost of boilers between the two countries is shown by the fact that in a case where Mr. Rockwood had obtained the best possible quotations for boilers made in England, and under circumstances which satisfied him that he really had the most favorable conditions under which boilers would be sold, he found they would cost about $9.75 per horse-power; whereas good first-class

American boilers to perform the same service, or in other words to supply steam for the same horse-power, would cost about $6.25 per horse-power.

Mr. Rockwood says there is also considerable difference in price between American and English engines, the English engine costing usually considerably more than an engine built here to do the same work, and that the terms of purchase here, regarding payments, etc., are considerably more favorable to the purchaser. His opinion is that builders of machinery and those engaged in the engineering trades generally in England, are much better off and are able to make money on considerably easier terms and conditions than is possible here at the present time.

▲ ▲ ▲

## Molding Large Pulleys.

BY L. C. JEWETT.

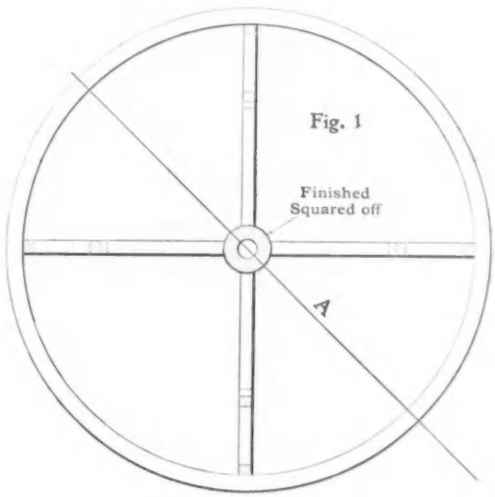
The departure, here suggested, from the methods usually employed in molding swept pulleys is shown in sketches Nos. 1 and 2; sketch No. 3 is the manner in which it was done forty years ago, and in all foundries to-day where hub and arms of pulleys are molded in dry sand cores, so far as I have ever seen. This method dispenses with the tedious and laborious operation of sweeping up the different levels, for bottom of hub core, elevation for arm cores, and level for bottom of rim and joint for cheek.

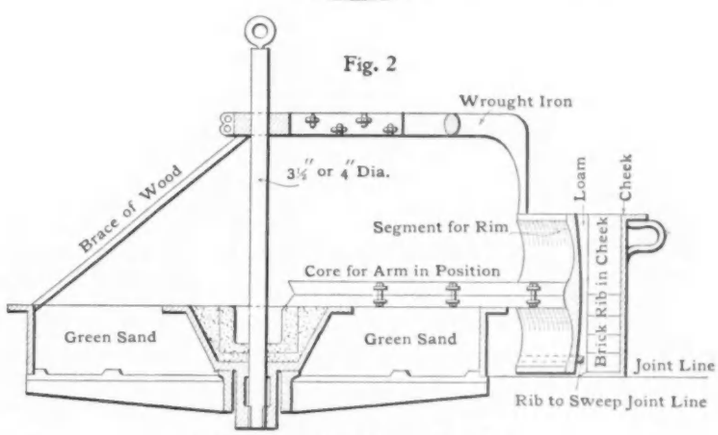
In the making of this kind of band wheel, or pulley, the molder, after getting his spindle gudgeon, or socket, true and plumb, puts on a sweep to get Fig. 3 worked out; and it is work, too, increasing as diameter increases. A large amount of sand is heaped about the spindle; quite a margin is allowed, as the sweeping of the different levels is much better if firm and full, than if scant places are found. After getting the sand rammed firmly, then they have to get the larger part away again to operate the sweep, to obtain the different levels before mentioned.

In foundries where such pulleys are made, there should be a floor selected where swept pulleys should have a home, as it were, and they should be made on that floor. Have a cross, Fig. 1, imbedded 2 inches below the floor level—this cross to be a permanent fixture and to have bosses, or shoulders, to center the rings to be hereafter mentioned; the hub of the cross to be bored out and squared off, so that the hub core box will drop right in with a loose fit. It might be necessary to line with brass to prevent rusting. The flange of hub core box and rings to be trued up to suit the level for the narrowest faced pulley liable to be required. The height of hub core box and ring flange is the required height for arm cores to bring arms in center of a 12-inch faced pulley, we will say. Should a deeper or wider faced pulley be required, cast-iron or wooden blocks could be placed under the arm cores to elevate one-half of the increase in face of pulley above 12 inches. The outside of this pulley mold, that is, the cheek, could be swept up in loam with some economy of time, and an arrangement could be made with two 2 x 6 or 8-inch planks of a length to suit each single cheek, to provide a center to sweep on the loam. These cheeks could be filled with bricks tightly keyed in, laid without mud or chinking, and made to do service for a number of times with a little patching, or they can be rammed up, as usual, with green sand.

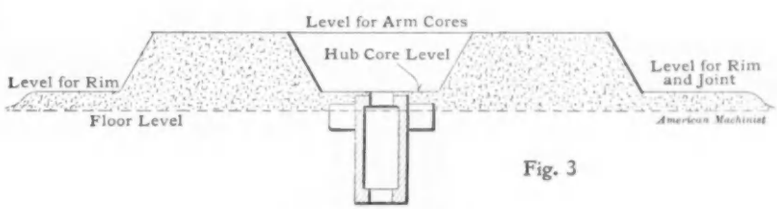
When we have all the appliances working, the process will be as follows: The molder sweeps up the cheek, with loam, and while that is being done the other fellow, laborer or apprentice, is getting the spindle center in the hub of the cross; the ring for arm elevation is rolled in, and falls to the center every time without measuring as to its being central or for height; sand is shoveled in between the hub core box and arm ring, where it will stay, it being only necessary to tramp it in until filled, when it could be given the butt of the hammer. Strike off even; lay in the hub core, then the arm cores; put in spindle with arm; fasten on rim segment for rim; and when the molder has the cheek done, the thing to do is to ram up the inside of the mold with green sand, as usual, all being done half a day or a day ahead of all time it has been my experience to witness.

Another advantage in sweeping up outside with an edge sweep in loam, and in-




CROSS SECTION — Through A of Cross




MOLDING LARGE PULLEYS.

side with a segment of rim for pattern, is that the segment can be made of any desired thickness, as the inside is the only part to be used, and a good wide fastening can be affixed securely at each end that will hold the pattern rigid, prevent springing when being rammed up, and further use of level will be unnecessary after once setting true and plumb.

I have molded pulleys with a segment made with outside and inside radius on the same pattern, and the pattern so thin that when ramming the outside, or cheek, it rammed in, and vice versa; so much so that the cheek could not be closed on. This was a thin rim, and more time was consumed in scraping and shaving, to get sufficient thickness, than would have been required to prevent the evil; and besides that, the pulley would be sadly out of balance, or liable to be.

The method described here will necessitate the centering of the cheek by measuring the thickness, but that has to be done now where they stake the cheek when closing for the last time. On the outside of the segment, near the bottom, is a rib put on to enable a sweep to be guided to make a joint for the cheek; these cheeks should be of iron, of course.

▲ ▲ ▲

## Machinery Exports.

The Monthly Summary of the Commerce of the United States, for the month of August, 1896, just issued by the Bureau of Statistics of the Treasury Department, contains interesting statistics of the export of machinery and other manufactures of iron and steel during the eight months ending August 31st, compared with the same period of 1895.

The following is a summary of exports by articles:

| | Eight Months, ending Aug. 31. 1895. | 1896. |
|---|---|---|
| Sewing machines | $1,849,775 | $1,907,216 |
| Printing presses and parts of | 123,103 | 243,629 |
| Fire engines | 2,145 | 8,500 |
| Locomotive engines | 1,175,943 | 2,436,065 |
| Stationary engines | 114,960 | 145,066 |
| Boilers and parts of engines | 198,729 | 419,341 |
| All other machinery | 7,451,260 | 10,785,702 |
| Total machinery | $10,792,812 | $15,740,371 |
| Builders' hardware and tools | $3,054,665 | $4,006,274 |
| Nails and spikes | 359,533 | 550,245 |
| Railroad rails | 251,420 | 814,912 |
| Scales and balances | 200,348 | 225,723 |
| Stoves and ranges | 166,265 | 191,541 |
| Wire | 876,989 | 1,057,750 |
| Fire-arms | 557,372 | 510,988 |
| Cutlery | 107,180 | 124,830 |
| Total mfrs. iron and steel | $21,952,102 | $29,057,090 |

Taking machinery (other than sewing machines) in particular, we find that the increased export has been mainly to Europe. The figures for the principa countries are as follows:

| | 1895. | 1896. |
|---|---|---|
| United Kingdom | $1,476,807 | $2,770,522 |
| Germany | 371,944 | 921,240 |
| France | 257,490 | 301,917 |
| Other European Countries | 628,565 | 2,445,125 |
| British North America | 1,014,066 | 1,062,408 |
| Mexico | 1,317,050 | 1,823,568 |
| Central America | 221,241 | 331,665 |
| Cuba | 281,622 | 109,118 |
| Argentina | 141,015 | 216,125 |
| Brazil | 1,193,749 | 776,434 |
| British Australasia | 205,383 | 463,374 |
| Africa | 760,609 | 999,851 |

While our total machinery exports increased from $10,792,812 in the first eight months of 1895 to $15,740,371 in the corresponding period of 1896, or nearly 50 per cent., our imports of machinery also increased in nearly the same ratio, the figures being $1,300,227 for 1895 and $1,892,840 for 1896. The exports exceed the imports fully eightfold.

▲ ▲ ▲

## Accurate Surfaces on Wood—Boring Square Holes—An Elevator Used for Weighing Machinery—A Box Tool—Hollow Mills.

It has long been the custom for a machinist to bring up the subject of scraped surface plates whenever he wanted to do a particularly impressive job of bragging and show how much finer his work is than others' work. He would tell how it is necessary to use three plates, and how, after the patient application of his transcendent skill, any one of these plates

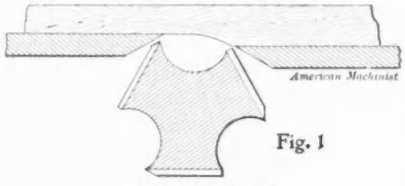



Fig. 1

PLANING WOOD.

would pick up and hold any other one after they had been rubbed together to exclude the air from between them. I used to indulge in this particular brand of bragging myself, but quit when I saw surfaces planed and milled that would do that; and when, in the shops of Bentel & Margedant, in Hamilton, O., they showed me two pieces of wood just from a planer, either one of which would lift and hold the other, I was again glad that I had gone into other lines of bragging.

It might be thought that these pieces of wood that I saw must have been planed on a Daniels planer, because it has long been an article of faith among woodworkers and machinists that a Daniels planer affords the only known means of producing true surfaces on wood by machinery. Most of us know that this planer is somewhat like our own machinists' planers, only that, instead of the machinist's cross-rail and tool held stationary while cutting, there is a vertical shaft with two arms at its lower extremity, these arms carrying at their outer ends cutters that sweep across the timber which is clamped to the slowly moving platen below; the truth and accuracy of the surface produced depending thus upon the accuracy of the ways, instead of being simply a smoother reproduction of the lower rough surface of the timber—as is the case where the cutters are fixed in a revolving cylinder above the timber, which itself slides over a fixed platen, is "fed" by grooved rolls, and held down by pressure rolls or bars. The pieces of wood which I saw behaving much the same as the machinist's superfine surface plates, were not planed upon a Daniels planer, however, but on a machine having a cutter head or cylinder just the same as those usually employed, only instead of being above, as usual, it was below, as shown in Fig. 1, which shows how the lumber passes over the cutter head and then onto a smooth, true surface, which forms the guide and keeps the lumber always in the same plane in which it starts to go through the machine; thus producing a plane surface, instead of one which possesses all the irregularities of contour originally in the piece. This is not a brand new idea; but, on the contrary, has been and is employed on many planing machines. It is universally employed in English machines, I believe, and it is quite certain that no other arrangement would produce such accurate surfaces.

### A CHIP REMOVER IN WOOD BORING.

We machinists are just beginning to fairly realize the importance of forcing lubricant to the end of our twist drills, thus not only getting the lubricant where it is needed (which we seldom did before), but also forcing the chips out. Those who make boring tools for boring wooden pipes, pumps, etc., have for some time been using steam for this purpose. They connect a steam pipe to the hollow shank, on the end of which is the cutter, and thus moisten the wood and blow out the chips. It makes an awful noise, however—such a noise, in fact, that the neighbors are apt to think it is better to do without wooden pipes, or even pumps. At Bentel & Margedant's they make a tool for this

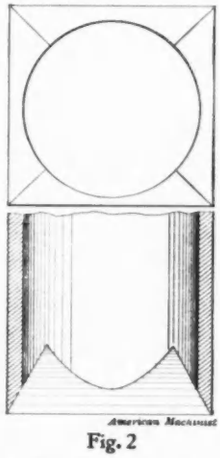



Fig. 2

A SQUARE HOLE CHISEL.

purpose which is more mechanical. Instead of putting steam through the tube, they put a screw in it, this screw being cut with such a coarse and deep thread that it resembles the spiral conveyors seen in grist mills more than a screw. This passes through the tube, reaches nearly to the cutter, is driven at high speed in the opposite direction, and carries the chips out without making any fuss about it.

### BORING SQUARE HOLES.

This job reminded me of a tool I once made to get square holes into a block of wood to hold a set of steel stamps—figures and letters. There were 36 of these, $\frac{3}{16}$ inch square holes to make, and the labor-saving tool in that case was a $\frac{5}{32}$ inch twist drill passed through the center of a square piece of steel of the proper size,

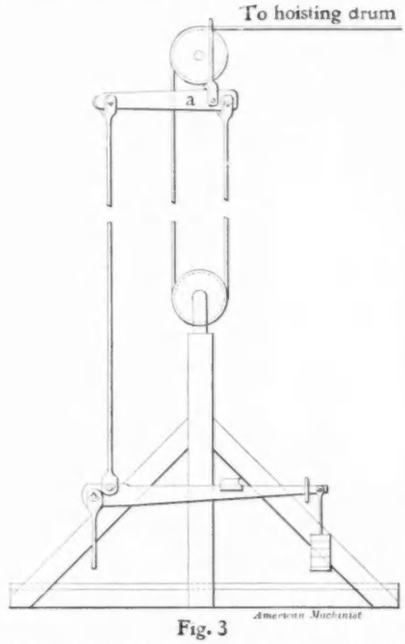



Fig. 3

AN ELEVATOR USED AS A WEIGHING SCALE.

and with its entering end made as shown in Fig. 2.

The drill just filled but ran freely in the hole passing through the square piece, projected about a quarter of an inch beyond it, and removed not only its own chips, but also those made by the square chisel in squaring out the corners, the latter being forced in with the drill by a washer placed against the drill chuck.

### AN ELEVATOR USED FOR WEIGHING MACHINES.

When machines are shipped from the Bentel & Margedant shop, they are either loaded upon an elevator to be taken down to the ground floor, or, if already on the ground floor, as is the case with their heavier machines, they are taken across the elevator platform to reach the door from which they emerge. This circumstance led to the adoption of a plan for making the elevator serve as a weighing scale, which, though not designed to be precisely accurate, is yet precise enough to determine shipping weights satisfactorily.

The arrangement for doing this is sketched at Fig. 3, where it is seen that, instead of attaching the hoisting cable direct to the cross-beam above the platform, it is passed round a sheave and up to a lever (*a*) fixed near the roof. To the other extremity of this lever is attached a rod which passes down to the scale beam. Half the load is thus thrown upon the lever *a*, which is placed in a diagonal position, since it is necessary that one end of it should be over the center of the elevator platform, and the other end over the scale beam, the latter being at one side of the platform and attached to the beams which support the shop floors.

It is an easy matter to so graduate the scale beam that the actual load will be shown within a small limit of error; the best manner of doing this being perhaps to place successively upon the platform a light, a medium and a heavy load of known weights, determine the notches for these, and then divide the intervening spaces upon the beam.

This scheme not only saves some time and labor in shipping, but, I was going to say, might prevent overloading of the elevator. It will not prevent overloading, but it might indicate to those who so persistently overload such elevaors what particular loads it is safe to ride with and when they had better take the stairway. I believe the superintendent, Mr. Gardner, told me it would weigh within a limit of error of somewhat less than 25 pounds, which he said was close enough for obtaining shipping weights.

### A BOX TOOL—HOLLOW MILLS.

There are a good many different kinds of box and other tools used in turret head machines for removing stock, and I give at Fig. 4 a view of one of them which was made by the Niles Tool Works. It is so nearly like my sketch of a similar tool, made and used by Mr. Parkhurst, superintendent of the Hamilton Cycle Company's shops, that it will do for both. Mr. Parkhurst considers it a very efficient and satisfactory tool, and, of course, its cylindrical shank can as well be fitted to go direct into the holes of a turret, which, in fact, is the form in which he uses it.

A hardened steel ring or bushing is used for a rest to support the work, and the tool has two adjustments, i. e., it may be tilted more or less to or from the center, or may be moved endwise by the nut on the stud, and it passes through a sort of tool-post or poppet which is slotted to receive the tool, and passes through to the rear side of head where a nut, not visible in the photo, draws it and the tool firmly to their places and holds them. The cutting tool itself is left rough; it requires no forging, and the rest of the tool is not subject to much wear. This is undoubtedly an efficient and all-round good tool for the purpose, but personally I am somewhat surprised at the extended use of single cutting tools for removing heavy cuts in the turret machine. It does not seem to me to be a case of the survival of the fittest, for I believe that the hollow mill with its three cutting points, when properly made, will remove stock just about three times as fast as any single cutter can, provided the machine in which it is used has ample driving power. It will not produce work quite as true where the stock runs out considerably, but where the stock runs true, the work will be good enough for a roughing cut, and it can be made true and smooth with a box tool afterwards. It it true that some tool makers do not get very good resuls from hollow mills; but so far as my observation goes, this is almost always because they attempt to do with them what they would not think of trying to do with any other tool; i. e., they

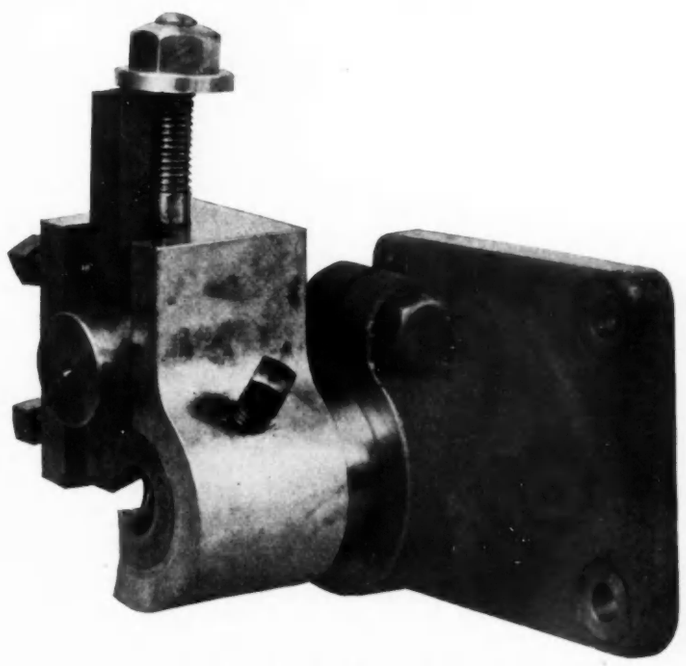


Fig. 4. A MODERN TURRET TOOL.

try to push off the chip, whereas a hollow mill should be made to cut the same as any other tool, and when so made it is marvelously efficient in removing stock.

I have seen hollow mills made about as shown at Fig. 5 wherein the cutting edges are formed by grinding to intersect with a surface which is milled exactly radial and in line with the axis of the work. Such

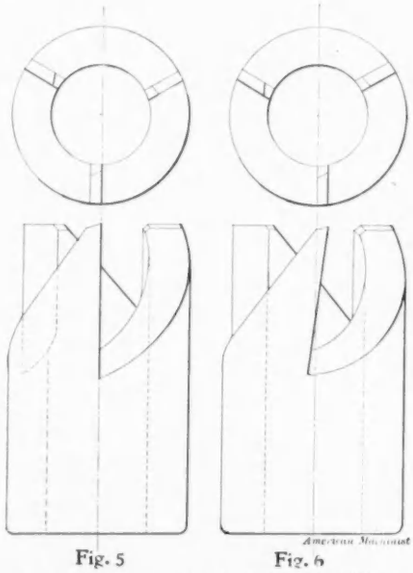


Fig. 5 Fig. 6

A BAD AND A GOOD HOLLOW MILL.

a tool should not be expected to be an efficient cutting instrument, and, as a matter of fact, it is not. It cannot be fed fast, and merely scrapes off thin, closely curled chips. But when a hollow mill is made about as shown in Fig. 6, it becomes a real cutting tool, can be fed so fast that each of its three cutting points will remove a heavy chip, and, since with reasonable care in grinding, the cuts are balanced against each other, there is little else than a pure torsional stress upon the stock and the main journal bearing of the machine. Such a tool, on work to which it is adapted, will remove stock about three times as fast as any single cutting tool I have ever seen.

It will be noticed that the end of the cutting tool in Fig. 4 is ground so as to give "rake" and enable it to cut. If it were ground square across, it would merely push or scrape off metal, and could not be made to do any real cutting; and yet, if the man who ground that tool were to make a hollow mill as shown in Fig. 5, forgetting entirely that cutting tools must be formed so that they can cut, he would simply be doing what very many of his contemporary tool-makers are doing; and if he should then conclude that the single cutting tool was the most efficient type of tool for a turret head machine, he would be making the same mistake that hundreds of others are making.

On some stock the cutting edges of Fig. 6 can be given still more rake than is shown, and one of the difficulties apt to be encountered by the tool maker who first tries to introduce these mills in a shop is that the men will not give them sufficient clearance on the inner beveled edges. If thrown very much ahead of the center, the clearance required to make them cut looks excessive and makes the cutting edges look weak. This is only in appearance, however, and a piece worker who has been using such a tool, each of its cutting edges taking a chip from 1-32 to 1-16 inch thick, which means 3-32 to 3-16 inch feed, and is given a single tool in place of it, will claim an advance in price, and convince you that he ought to have it, too.

S. T. FREELAND.

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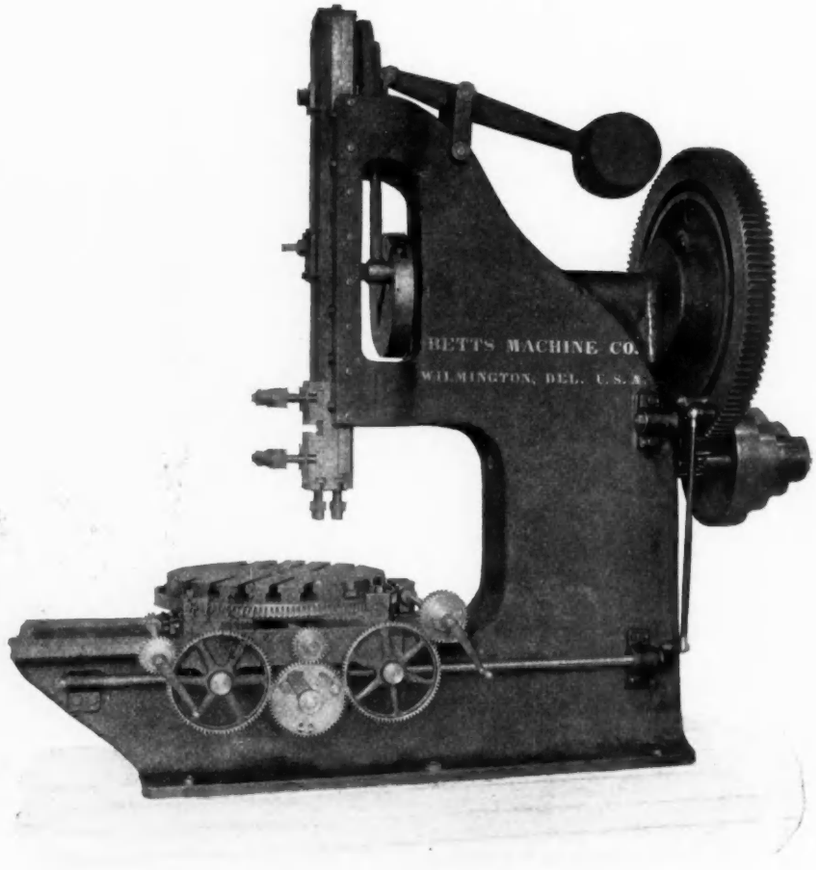
## Fifteen-Inch Slotter.

We have previously mentioned the fact that American tool-builders have supplied a complete plant for building locomotives in Russia, which plant was shipped to Nijni Novgorod some time since. Most of the machinery was built in Philadelphia and vicinity, and we give herewith an engraving of a slotter which was included in the plant and was built by the Betts Machine Company, of Wilmington, Del.



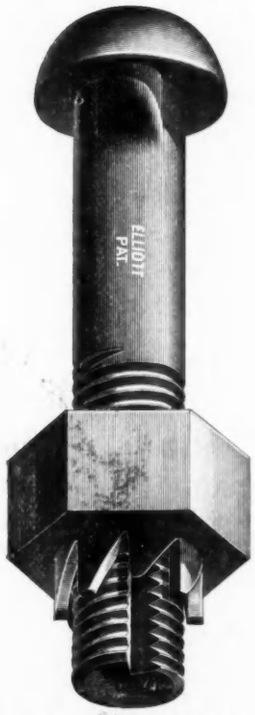

ONE OF THE TOOLS SENT TO THE RUSSIAN LOCOMOTIVE SHOP.

The photo makes the construction and general proportions quite clear, and it will be noticed that things are so arranged that the workman can handle the machine from one position, and that the one generally most favorable for watching the operation of the tool; every movement of the compound table being made by crank handles which are attached to the saddle. The crank at the right gives the rotary motion by hand; that at the left the motion of saddle upon the bed-plate, while the central screw moves the table at right angles. These shafts and the screw are all squared for the reception of the cranks, and automatic feed motion is transmitted to them by the gearing shown; the arrangement being such that the feed always takes place when the tool is in its highest position. The feed is obtained from the cam track seen inside the large gear wheel, and the amount of feed is regulated by the plate in front of the saddle.

Rectangular guides are used for saddle and ram, and in other respects every effort has been made to have the machine represent the latest approved practice. The table is graduated; the bar returns 3 to 1; there are eight rates of feed; the stroke is 15¾ inches; the machine will slot to the center of 63 inches; table moves 38 inches longitudinally and 30 inches transversely; revolving table is 33 inches diameter and can be clamped in any position; and the worm which rotates it can be readily disengaged to facilitate setting of work.

## A New Locking Nut.

Many devices have been invented for firmly securing nuts on bolts where the tendency is for them to loosen, and we present herewith the latest of these, which,




A NEW LOCKING NUT.

as will be seen, involves no extra parts, but simply the formation of what may be called a series of saw teeth around the edge of the tapped hole in the nut. These are formed by the dies used in making the nut, and a groove is milled in the bolt in such a way that, when the nut is tightened, one of the teeth referred to can be bent down so as to engage with the groove, and thus prevent the nut from rotating upon the bolt until the tooth is sprung out again.

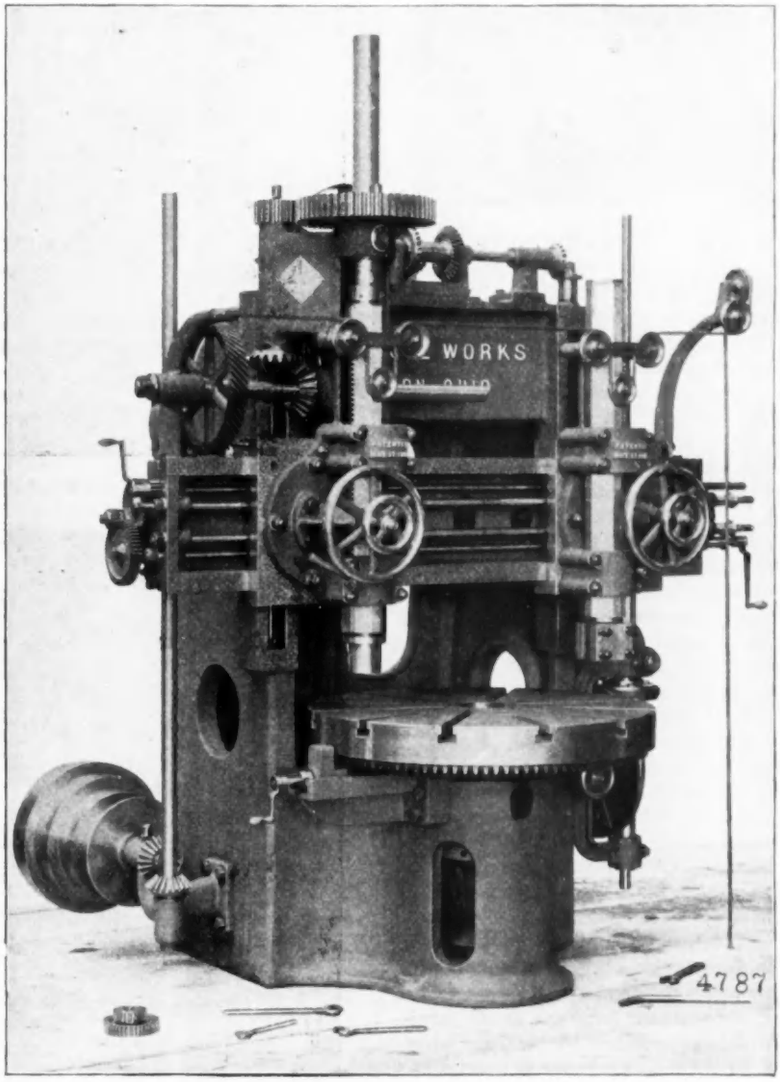
This is the invention of Sterling Elliott, and is being successfully used in car construction, for fastening threshing machine cylinder teeth and on other machinery, as well as for track bolts. The nut is made by the Elliott & Hatch Nut Lock Company, 514 Postal Telegraph Building, New York City.

▲ ▲ ▲

## Boring and Turning Mill with Extra Head.

We present herewith an illustration of a boring and turning mill having a special head fitted to the cross-rail, by means of which holes may be bored in any desired position in work clamped to the face plate.

As will be seen, the mill is provided with the usual turning and boring head, which operates by the revolution of the face plate and at the left carries the extra head referred to, which has a traverse feed motion on the rail and can be used for facing or turning if desired, but the special object of which is to bore holes in the work while the face plate is held by the locking device seen at the left of the machine; the spindle being then driven by the supplementary driving arrangements shown also at the left. This independent boring bar is adjustable for wear, is counterweighted and has a power feed. It considerably extends the range and variety of work which can be done upon the mill, especially where it is desired to bore eccentric holes through work which has been turned and faced upon the mill in the usual manner, all at one setting of the work. The nominal size of the mill is 37-inch and it is built by the Niles Tool Works, Hamilton, O.




BORING AND TURNING MILL, WITH EXTRA BORING SPINDLE.

## Crosshead Wrist-Turning Trap.

FROM THE DE LA VERGNE SHOPS.

If a crosshead wrist pin is cast solid with the crosshead it is a good, tight, solid job, and does not have to be "extra well fitted" to keep it from working and wearing. The joining made between two members of a structure by the solidifying of the one body of fluid iron is beginning to be quite generally recognized as a very substantial and cheaply formed union, both for framing members and moving pieces, and there is a constantly growing tendency among good designers to fasten all members of any cast-iron structure which are to be finally immovably secured to each other, in the sand, because one single piece is always better than two pieces, no matter how well they are put together.

This practice of combining pieces in one casting goes even to the extent of making large four-side frames in one piece, with all the lugs, horns, and pedestals cast on solid, as in case of the "Linotype" frame, cast by the Fulton Foundry, Brooklyn, which I show here, not because it has to do directly with turning crosshead wrists, but because it is a fine example of modern practice in single-piece machine framing.

This single-piece practice is not new; it is old. Our grandfathers understood just as well as the very best designers now know, that every added joint and fitted surface is a possible source of danger and annoyance, and some of the old ones went

to great lengths in the direction of many-membered single-piece structures of cast-iron. The patterns for a piece like the "Linotype" frame shown in Fig. 1, cost a lot of money, and the molding calls for

Fig. 1. LINOTYPE FRAME.

good flasks that will come together twice alike, and careful molders who have something besides beer in their heads; but such a number of members cast all in one piece does away with a great deal of surfacing, fitting, scraping and doweling, and drilling and tapping and screwing home of bolts which may make any of them come loose any day, no matter how carefully the foreman thinks the work has been done. Crossheads were made in one piece for a long time before somebody thought it would be a good thing to seat loose wrist pins in round holes bored through at right angles to the piston-rod seat, because where the wrist is cast solid with the slide jaws and piston-rod eye it is not easy to finish it. The solid wrist can be chipped and filed after the crosshead is planed. A good vise hand, style of 1840, used to make a good, quick, true job of crosshead wrists, and this method of wrist-fitting was much preferred by the cubs to "jacking" in the lathe. The "jacking" method consists in centering, putting the job on the lathe centers, and turning the wrist pin with a "reach-up" tool half way around, and with a "reach-down" tool the other half way, the motive power for these numerous half-revolutions of the crosshead being furnished by the cubs previously mentioned, operating at the end of a piece of scantling, of greater or less length, driven into the piston-rod eye of the crosshead. If there was much to come off the wrist pin, and the lathe hand was disposed to make the cub sweat, the cub did sweat over his end of the job, sure enough. Some shops chipped and filed the wrists pretty nearly right after they had been centered and marked in the lathe, and put them back in the lathe for a finishing scrape; this was not so hard on the cub, but it took a good long time all the same, and it was quite fashionable for a while to make loose crosshead wrists; an easy job all around, only the loose pins had a way of keeping their name good by working in their seats in the course of time, so that it is now again fashionable to make the crosshead wrists solid with the remainder of the piece, although they are just as difficult to finish as they ever were.

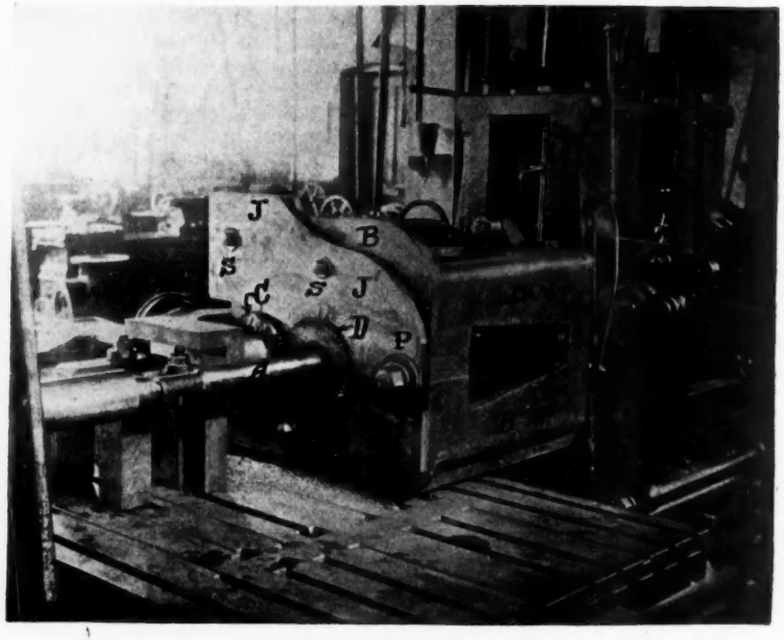



Fig. 2. DE LA VERGNE CROSSHEAD WRIST FINISHING.

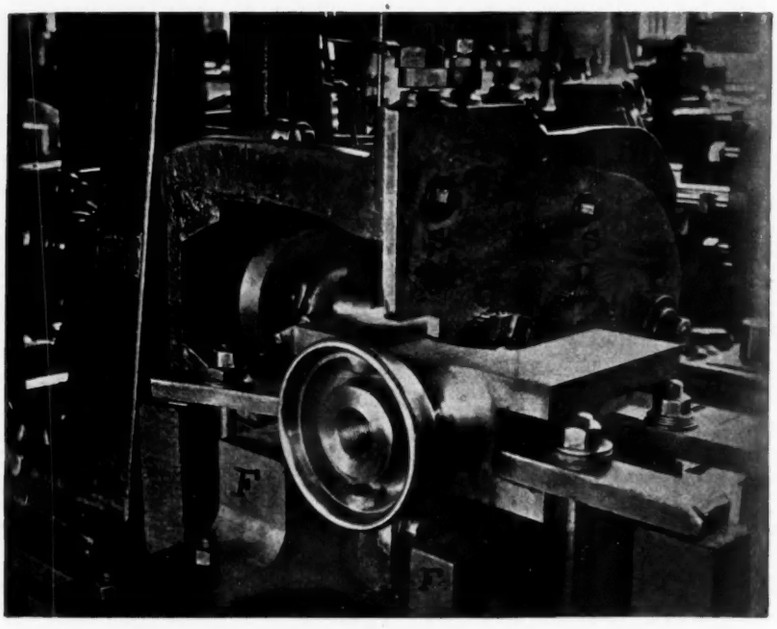



Fig. 3. DE LA VERGNE CROSSHEAD WRIST FINISHING.

The De La Vergne shops took the bull by the horns, and made the trap shown in Figs. 2, 3 and 4, to go in the boring mill and turn crosshead wrists. This arrangement is used with a common horizontal boring machine by Nicholson & Waterman. Similar arrangements could be used on an engine lathe, but the horizontal boring machine is the more convenient, because it has flat head-stock front uprights to which the box or frame of the wrist-turning trap can readily be secured, and because the boring mill traveling table is suitable for carrying the crosshead bolted to it while the wrist-turning is in progress.

The broad idea of the De La Vergne wrist-turning trap is to carry a turning-tool on a hollow revolving piece which surrounds the wrist to be turned, as the wrist has neither end free, and consequently nothing can be slipped over it. Hence, the hollow revolving tool carrier

is made in two pieces, shown in several sizes in Fig. 4. Because a crosshead wrist is comparatively short, these tool-carriers are made as narrow as possible; they should in all cases measure less than one-half the length of the cross-head wrist they are to turn, in extreme width, measuring from the outside cutting face of the tool to the other opposite face of the carrier. As the space back of the wrist is always small, the total diameter of the tool-carrier must be small, and different diameters of carriers must be used for different diameters of wrists, and different diameters of journal or head-stock boxes must be provided to support these carriers while at work. Again, as the space for the carriers is limited, and they must be strongly and steadily driven, these carriers are made in the form of split spur gears with large bores, tongued and grooved or rabbeted to prevent radial slip (which might produce untrue wrists), and grooved in the middle outside to form a very narrow journal on which the carrier runs as it revolves. In some cases, and perhaps in all cases, the halves of the split carrier are held together by two side plates screwed in place, as at *S*, *S*, Fig. 4. The journal of the carrier is made either flat-bottomed, as at *F*, Fig. 4, or V-bottomed, 45 degrees total angle, as at *V*, Fig. 4, which, however, does not clearly show the V-shape in the picture. The V-shape is preferable to the flat bottom. The turning tool is secured in a dovetail seat, about 10 degrees on a side, by a dovetail taper key, all as quite clearly shown at *K*, Fig. 4. Fig. 4 gives a sufficient idea of the general proportions employed to enable any tool-maker to produce a similar machine.

Supposing a crosshead bolted down to a horizontal boring-mill table, with its planed jaws set accurately at right angles to the line of table travel, with a tool carrier as described embracing the wrist to be turned; this tool carrier must be revolubly supported, and supported firmly and closely, and means to rotate the carrier must be provided. To this end a box *B*, Fig. 2, planed parallel on its front and rear ends, is bolted to the boring-mill head-stock upright as shown, with its under surface just clear of the boring-mill table. To the front end of this box two bearing jaws *J*, $J^1$ are secured, $J^1$ being bolted fast, while *J*, the upper of the two, is pivoted at *P*, and in addition has two holding screws *S*, *S* passed through it and screwed into the front plate of the box. The two bearing jaws *J*, $J^1$ have each two partial boxes formed in their meeting edges—one bored in line with the boring-mill centers, and serving as a journal in which the driving gear *D*, Fig. 2, revolves, *D* being carried on an arbor on the boring-mill centers and dogged to the boring-mill live spindle. The other journal in the meeting edges of *J*, $J^1$ is fitted to the carrier which is used for the size of crosshead wrist to be finished, and these two journals in *J*, $J^1$ are such a distance apart as will make the teeth of the driving gear *D* and the carrier *C*, Fig. 2, mesh correctly. It is obvious that if the screws *S*, *S* are removed, and *J* is turned on *P* over to the front in Fig. 2, then the arbor *A* carrying the driving gear *D* can be placed, and the crosshead can be adjusted by the cross screw of the boring mill table so as to be centrally embraced by the halved carrier *C*. This makes it a perfectly simple matter to set the crosshead

Fig. 4. DE LA VERGNE CROSSHEAD WRIST FINISHING.

wrist correctly for finishing, the fixture *F F*, Fig. 3, being the right height to make the middle of the wrist lie in the axial plane of the carrier *C*, or the box and driver arbor may be adjusted vertically. I think, however, that the height of the box is fixed, and the crosshead holding fixture is made the correct height to bring the wrist in the middle of the slide jaws.

To commence turning the wrist, the jaw *J* is turned over to confine the driver *D* and carrier *C*, the screws *S*, *S* are turned home, the power put on, and the cutter driven down with a hammer as *C* revolves until it makes a full cut as far as possible toward the head-stock side of the crosshead. Then the feed is put on and the wrist is turned up to the shoulder on the tail-stock side of the crosshead. Then the machine is stopped, *J* is released and turned up out of the way, and the carrier is turned over in its bearing so that the cutting tool faces the head-stock, *J* is again secured in place, and a cut is taken over the remainder of the wrist up to the shoulder on the head-stock side.

Although it has taken so many words to fully and exactly describe this wrist-turning trap, it is really very simple, and not at all costly, and it is very rapid and satisfactory in action, and is a valuable addition to the equipment of any shop where crossheads of the solid-wrist type are a regular product

JOHN RANDOL.

▲ ▲ ▲

## The Mechanical Engineer.

The recent death of J. F. Holloway led us to look up, among other things, his address as President of the American Society of Mechanical Engineers, delivered before the Society at the Boston meeting, November, 1885, and we venture to reproduce some portions of it, feeling assured that our readers will thank us for so doing, as it is of high and lasting value, and as suggestive and stimulating as it was ten years ago:

* * * * * *

"The term 'engineer' is a generic one, capable of being divided into a great many subdivisions; just how many it is difficult to say, as the necessities of civilization and the advancement of science have made it necessary to add new specialties, each of which is of sufficient importance to occupy the full time and energy of a special engineer in order to master and direct its details. While I would render honor to all branches of the profession of engineers, and would most certainly underrate none, I cannot but believe that the mechanical engineer stands the peer, not only of any other engineer, but of any other man as well, in depth and breadth of usefulness, and for the reason that for the final consummation, and for those final practical results which best promote the comfort, safety and progress of humanity, as well as by reason of the fact that he, most of all, is concerned in the molding and directing of the material forces of Nature. It was well and truly said by one of the founders of this society, that the profession of mechanical engineering underlies all engineering, and it requires but a moment's thought to make this apparent.

"While the civil engineer may plan and locate his railways, canals, aqueducts, bridges and tunnels, it is the mechanical engineer who is called upon to devise the machinery and tools with which they are to be constructed. The naval or military engineers, guided by the experience of the generals and warriors of the past, may plan defenses by land or sea, may design forts or ironclad ships; but when their resources are exhausted, it is the mechanical engineer who is called upon to build the ships, load them with defensive armor, and not only to provide them with powerful guns, but also to provide the mechanism by which not only the guns are to be handled, but by which the ship itself shall be maneuvered and driven, alike through stormy as well as calm seas.

* * * *

"How helpless would sit the mining engineer above his earthbound treasures, be they never so rich, did not the mechanical engineer come to his aid to free them and to lift them from out their rock-ribbed home, and with fiercely fanned furnace fires free them from their impurities and dross!

"Even the giddy goddess, Fashion, whose ways none can fathom, would, like Alexander, sigh in vain for other worlds to conquer, did not this same mechanical engineer, like gallant knight of olden

time, come to her aid, and with ingenious and studied transformation of wheels and cams, and flying shuttles, bring new combinations to woof and warp, whereby the silken threads, turned into new channels, reveal a hitherto hidden beauty, which for the time captivates all beholders. And so it is through all the industrial pursuits of life which require for their prosecution the handling and the transformation of crude materials into forms of usefulness and beauty.

* * * * * *

"While it is true that scientific and technical training is, and must ever be of great advantage to the mechanical engineer, there is yet another source from which, after all, he will derive by far the most benefit, and that is—experience. Not necessarily his own experience, but the experience of others, and of all ages as well. And I know of no other way in which he can be so benefited and aided all through his life. I ever think of experience as a vast storehouse, the cornerstone of which was laid upon that day when the unbarred gates closed behind our first parents as they left the paradise of Eden, a storehouse to which each successive day since that time up to yesterday has added extended length and increasing stores. In this vast edifice every man of every occupation or profession has had his nook in which to pile up the experiences of his life. Of the great mass of knowledge therein stored, hidden by the accumulated dust of ages, little has come down to the present; but who does not regret that more cannot be known of the members of our own profession who in remote ages builded so well that even the ruins of what they accomplished challenge our admiration now? What an addition it would be to the literature of engineering could we have the clearly interpreted published transactions of those engineers who, thousands of years ago, built a Suez Canal through a country in which in our day De Lesseps could do no better than to follow! Could they be spread before us, how much of interest would cluster about the discussions of the mechanical engineers who planned the Pyramids, and contrived and executed plans for quarrying, transporting and erecting those numerous obelisks which once dotted the plains of Egypt!

* * * * * *

"While it is true that we may go to that garret in Heathfield where he whom we are pleased to call the father of the steam engine, James Watt, lived and labored, and while we may stand beside the bench whereon he worked, may see the lathe which yet has in it the unfinished job he left there, and beside which his leather apron lies as last he laid it down, and while all these, from their associations, would be of especial interest to us all, who know how much the onward progress of the world was hastened by what he accomplished for the steam engine, there will still remain much which we shall never know of James Watt and of his experiences.

"None will ever look upon James Watt's scrap heap; none can do more than imagine of his studying, his planning, his model-making, his trials and his failures, as he worked out the problems of expansion, contrived the condenser, air pump, valve motion, governor, indicator, and, indeed, every important feature of the successful steam engine of to-day. That he had a scrap heap which received his failures we may well believe, for where is the engineer who has accomplished anything worthy, who has not hidden away in some secluded nook, or corner, his pet schemes that came to naught, his long-dreamed-of hobbies which some inexorable law of Nature defeated, his neglected but never quite relinquished models, which were to work wonders, and over which at long intervals he sits and dreams, and promises himself at some time in the future to take in hand and work out to a successful ending?

* * * * * *

"While it is possible, by the aid of history or tradition, to trace back to their origin some of the innumerable inventions which have so benefited the world, how many yet remain about which nothing is now or ever will be known! Think for a moment of the vast host lying in unknown graves, who, in the past, amid poverty and discouragements, toiled from early morn until the night was well spent, in some obscure garret, or smithy, or workshop, to devise and perfect some simple machine, to contrive or manufacture some article now so common, so universally used, that its sudden removal would work a world-wide injury! While none will question the value of the engineer in aiding the progress of the past, all will, I think, agree that at no time in the history of the world was he so important a factor as he is to-day.

* * * * * *

"Putting aside all the wondrous history of bygone ages, blotting out all the engineering triumphs of the Middle Ages, calling the time of Shakespeare and Milton antiquity, and coming down to within a brief century, or, if you will, to the brief span of a single generation, and what, or rather what not, has the mechanical engineer accomplished. So broad, so varied and so universal has been the field of his action, and of his triumph, that I find no time to begin even an enumeration of what he has done. A thoughtful woman, gazing at the ceaseless, steady action of the immense engine, driving with tireless speed the ponderous steamship through storms and calms, said, half in soliloquy, but wholly in earnest: 'Engineers ought to wear crowns.' While it is true that, at least in this country, the position of any man or set of men will be what they themselves make it, it is nevertheless a fact that the public at large are wont to accord eminence and praise to those most in view and oftenest heard. In the history of the olden time it was the kings and rulers who occupied much of the attention of the public. Later on, and for a much longer period, it was the chieftain, or warrior, whose praises were sounded by the orator and the poet, and the prowess, the bravery and chivalry of the knight errant, surrounded with environments of waving pennons, floating banners and glittering armor, was the theme of poetry and song through many ages.

"Hannibal and Napoleon, with their armies, crossed the Alps. Their pathway amid the clouds was strewn with thousands upon thousands of those who fell by the way, and of the proud armies who at their base began the ascent, comparatively few reached the sunny plains beyond.

* * * * * *

"Long years after these warrior chieftains had crumbled into dust, a mightier than Hannibal or Napoleon came to the foot of those rockbound barriers and bethought him of a better way. Seeing near by a dashing torrent, which for ages had, unconfined, tossed high in air its flakes of foam, he knew he had in that a giant force to do his bidding; so, curbing and guiding its wild spirit, he bade it turn his wheels, swing his cranks, move to and fro his ponderous plungers and pistons. He made swinging valves, at each opening stroke, to gather in that wildest, freest and most untamable of all the elements, which "bloweth where it listeth"—the air—and driving it before him through long and tortuous passages, he made it knock with arm of steel upon the portals of the hitherto impenetrable walls. With highest skill and unceasing industry, he bade the spirits of the air and water alike to do his behest, guiding them to the right and to the left, up and down, as occasion required, and from either side, through months and years, until at last the hitherto defiant walls were broken down and the eager men leaped through the rent mountain, not to engage in deadly conflict of savage hate, but to clasp each other in hands of equality and fraternity. Through this open portal to-day, on roadway of steel, luxurious carriages glide swiftly and securely filled with the inhabitiants of all lands on errands of pleasure, peace and good-will. Other vans loaded with the products of the field and vine, the spindle and the loom, alike pass from Italy's sunny plains to the north land of snow and ice, for barter or exchange.

"Need I ask who conquered the Alps; the soldier or the engineer? Need I ask whose triumph has contributed most to the welfare of all the world, the generals who went over the Alps, or the engineer who went through them?

* * * * * *

"Let it be our ambition so to conduct ourselves that we shall ever honor our

calling, and shall assist in raising it in the estimation of all, to that high position of honor and usefulness to which, by reason of what it has done and is doing for the world and humanity, it is so justly entitled!"

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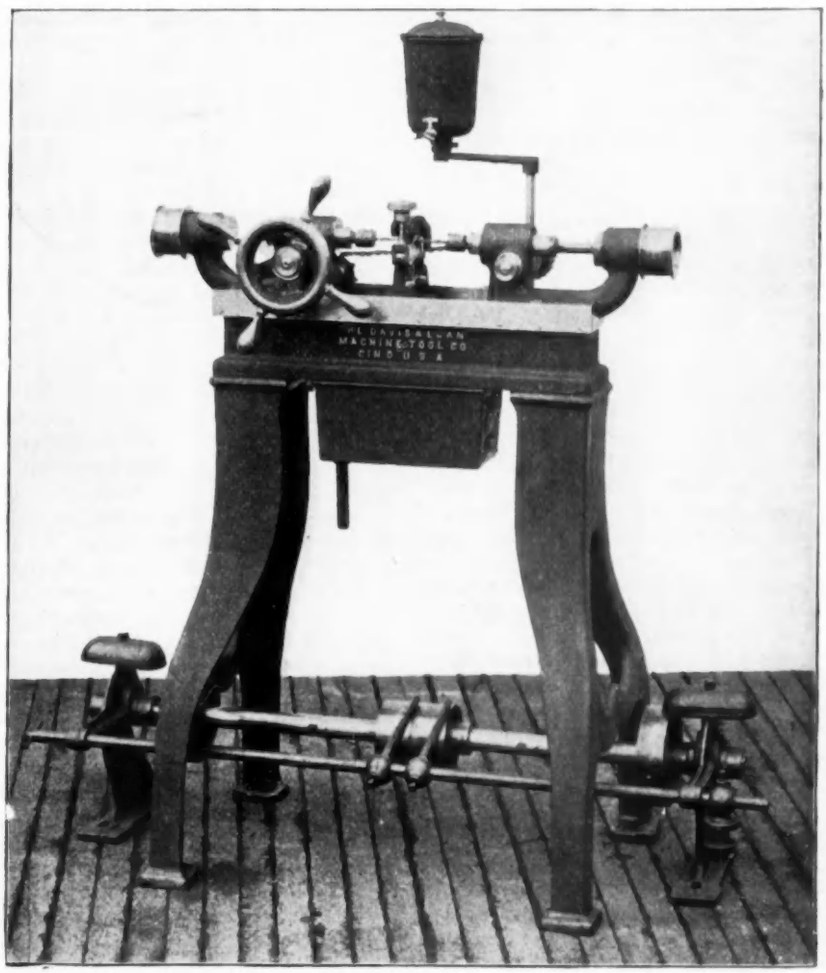
## Chain-Link Drilling Machine.

We present herewith an illustration of a machine designed for drilling links of bicycle chains. The machine consists essentially of two heads which are mounted upon a suitable bed and carry spindles driven in opposite directions, so that the ordinary right-hand drills are used in both. The link to be drilled is held in the fixture at the center, and the drills pass through steel bushings and are fed by the hand-wheel at the left. The chain is seen at the rear, transmitting the feed motion from one head to the other, so that both spindles are fed simultaneously by rack-and-pinion movement.

The belt pulleys have an independent bearing in the heads, so that no side-pull or strain from the belts is thrown upon the spindles.

The top of the bed is surrounded by a raised edge which confines the oil or other lubricant used and causes it to flow into the pan below, from which it is taken to be used again. The machine is made by the Davis & Egan Machine Tool Company, Cincinnati, O.




CHAIN-LINK DRILLING MACHINE.

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## Fallacies in Boiler Practice.

We are always being confronted with flourishing reports of new things which have effected economy, and they are praised up and talked about by everyone entirely without a proper recognition of the true cause of their success.

There is now going the rounds of the press an account of the benefits that have been obtained from so-called retarders placed in the fire tubes of boilers. The idea is that they serve to retard the draft, and so keep the hot gases in contact with the heat-absorbing surfaces for a longer time. This idea is quite fallacious. Any longer time of passage of the gases through the flues would mean less power to burn coal, and the effect, if needed, is to be got at once by the use of the damper. The bottling-up or retardation of the products of combustion is absolutely useless, unless, perhaps, there is a plenum in the stoke-hole and the chimney damper is made use of to hold the plenum.

Clearly, the name "retarder" has been given to the appliance in question under the idea that the benefit arising from its use is due to retardation. What is this retarder? It is a twisted length of flat sheet iron pushed into the tube. Being twisted, it mixes up the gases and brings all into contact with the tube surface; and it is pretty clear that an economy does result, but it is equally certain that the true cause is not either mixing or retardation. The addition of a retarder strip adds about 60 per cent. to the contact surface of each tube with the gases. The strip absorbs heat from the gases, and radiates such heat to the colder surface of the water-cooled tube which surrounds it. In place of being called a retarder, it should be called a radiator, for it acts by radiation.

Exactly the same effect is obtained with soot. When we abolish black smoke we often find it difficult to secure the same evaporative effect. The reason is that pure colorless gases possess very little radiating power, as we may tell by approaching near to a Bunsen flame. If, however, we mix soot with the colorless gas, the particles of soot will absorb heat from the gas and will radiate it to the tube surface; hence the difficulty of securing economy and smokelessness together, and the necessity of using radiators in some form.

The use of blast furnace gas for steam raising in ordinary boilers has long been recognized as very wasteful, and all these purple-burning or carbon-monoxide flames are very useless as heat radiators. They can only impart heat by contact with bodies such as firebrick, which in turn, being solid, impart their absorbed heat to cooler surrounding bodies by radiation.

Somewhat similar effects are obtained by the appliance known as Serve ribs inside fire tubes. In this instance the radially projecting ribs absorb heat from the gases passing through the tube and conduct it to the cylindrical body of the tube. The success of the Serve ribbed tube lies in the fact that when we have succeeded in getting heat into the metal of a tube, it is easy to get the heat through the tube, because the conducting power of the metal is greater than its surface absorption. Consequently, we may safely increase the heat-absorbing surface, with the assurance that all the heat absorbed can be easily conveyed to the water through the body of the tube. Were this not the case, the ribs would burn away. It is a well-known fact that any piece projecting inside a boiler firebox will burn away until it is short enough to absorb no more heat than can be passed along its point of junction to the water-cooled plate. If the area of such a projecting bolt or pin be measured, then the ratio of its area to the area of its cross-section where it joins the plate may be taken as marking the relative ability of the material to absorb and convey heat.

W. H. Booth.

# ELECTRICAL MACHINERY.

## Ball Step Bearing and Magnetic Brake of the Sprague-Pratt Electric Elevator.

The increasing use of ball bearings for miscellaneous purposes, renders any information regarding their construction of value at the present time, and we have to thank the Sprague Electric Elevator Company for the courtesy of a working drawing of their ball step bearing, with permission to publish the same.

Our readers will recall the ball nut of which we published a description recently, under the title of the Sprague Electric Elevator, but which we should have called the Sprague-Pratt Electric Elevator, its proper commercial title. To the ball nut this step bearing is a companion. The ball nut and rope sheaves being driven by a screw, there is, of course, a heavy end thrust to the screw, and the provision of a satisfactory step bearing is almost as important a matter as the nut itself. The sheaves are, of course, multiplying sheaves, and the forces to be dealt with are correspondingly heavy; in fact, so far as we are informed, the loads carried by these bearings are heavier than have been attempted with balls before. In this sense, the bearings are far removed from applications where the loads are comparatively small. Bicycle bearings, for instance, furnish a small basis from which to predict the performance, or on which to found the design, of bearings for mill machinery; but with a successful bearing of the size here given before us, he would be rash who should deny a large future for ball bearings in the heaviest class of work.

The importance of this bearing as an illustration of the capabilities of ball bearings, will be seen from the magnitude of the loads which it carries. These loads run up to 64,000 pounds, measured from the unbalanced static weight of the car and its contents when the car is fully loaded. In point of fact, the friction of the machinery and the load due to the acceleration of the car must give a considerable addition to even this figure.

The bearing has 180 balls, so that the load per ball is 355 pounds. The ball nut, of which we gave an illustration recently, has 240 balls in action, giving for the balls in the nut a load of 266 pounds per ball. The balls are one-half inch in diameter in all cases. In this connection we should say that the figures given in our article on the ball nut, for the load carried by the balls, are subject to revision. Those figures represent old practice, and later experience has shown that they may be largely exceeded. We make the correction here in the interest of accuracy.

Our engravings, Figs. 1 and 2, show the construction of the bearing and surrounding parts. The central shaft *a* is a prolongation of the screw, the electric motor occupying an open space in the frame, of which one end is shown at *b*. The lay-out of the machine is such that the screw is always in tension. The hardened steel plates between which the balls revolve are shown at *c d*, plate *c* resting upon a soft seat of lead interposed between it and the frame. Plate *d* is carried by the screw, being backed up by the washer *e*, a similar lead seat being interposed between plate and washer. Experience has shown that it is impossible to obtain satisfactory results with the washer rigidly attached to the shaft. Even though faced in position on the shaft, it is still liable after removal to be out when replaced. To overcome this difficulty, a ball-and-socket joint is interposed between the washer and nut, as clearly shown. This ball-and-socket enables the collar *d* to take a perfect bearing on the balls.

The most interesting feature of this bearing, however, lies in the arrangement of the balls. A distancing plate is, of course, necessary to keep the balls in their positions, which plate is shown in position in Fig. 2, and in detail in Fig. 3. It has been customary in previous thrust bearings to arrange the holes in the guide plate in circles, the effect of which arrangement is, of course, to make the tracks of the balls on the plates a similar series of circles, with a tendency to wear the plates in grooves. To overcome this tendency, the holes in these guide plates are laid out in spiral lines, as clearly shown. In point of fact, there are two spirals, the whole forming, so to speak, a double-thread spiral. A comparison of the positions of sucessive balls in the spirals will show that each ball and its diametrically opposite mate have a circular path to themselves, and that the paths of adjacent balls differ so little from each other as to bring the entire surface of the plates into use, and thereby prevent the formation of grooves. An examination of Fig. 2 will show how small a portion of the surface of the plates would be brought into service were all the balls in the same circles as those shown in the section, and how much the life of the plates must be increased by the distribution of the wear due to this device. At the same time, the absence of grooves in the plates increases very largely the durability of the balls.

The drawings also show the arrangement of the magnetic brake with which the machine is provided. This brake is not used for stopping the car, but for locking it in position after it has been stopped by electrical means. The brake wheel was formerly attached directly to the end of the screw, but the overhang from the bearing was such as to be objectionable. A casting *f* is now bolted to the end of the frame, serving at once as a cover for the step bearing, and also as a special bearing for the brake wheel. It will be seen to project within the brake wheel and to take all the pull of the brake strap. The brake wheel is driven by the screw through the medium of the sleeve *g*, which is keyed to the screw and has its flange arranged to engage the hub of the brake wheel, on the principle of a claw clutch, the claws being shown at *h*, Fig. 1. The magnetic coil for applying and the spring for releasing the brake will be recognized at *i* and *j*.

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## Electric Locomotives on the Elevated Railroad.

The electric locomotive now under test on the Thirty-fourth street branch of the elevated railroad of this city is a renewed attempt to make use of the storage battery, though on a different plan from what has been tried heretofore.

In previous experiments the motors were to have been charged at the power house and then to supply the entire current for moving the trains. In the present case the road is fitted with a third rail to serve the purpose of the usual overhead wire, and line current and battery current are used in combination, the office of the batteries being to act as an equalizer of the draft on the line. When the trains are standing at the stations, or are on down grades, the batteries are being charged from the line; and when the engine is putting out effort, the current is derived partly from the line and partly from the batteries—the attempt being to make the draft on the lines as nearly uniform as possible, and thereby give a better chance for economical generation at the power house. At the same time the batteries contain a sufficient store of energy to prevent stalling in case of a breakdown at the power house. One of the great points claimed for this store of energy on each engine is its use in starting trains in case of a blockade. Without the accumulators an enormous current from the power house would, of course, be necessary to get the trains under motion again; but this is avoided by the provision described, as all surplus above the normal is supplied from the batteries. An important saving in copper is also claimed over what, without the batteries, would be necessary in the conductors in order to maintain adequate pressure at the far end of the line under the conditons of the service.

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Nansen's steamship "Fram," in which the late polar expedition was made, was equipped with an electric-light plant which derived its power from a windmill. This was rendered possible by the use of a storage battery which was charged by the windmill, and which in turn gave out a steady current to the lamp. The light did much to mitigate the dreary all-winter night of the Arctic regions, and is said to have worked well until some of the gearing wore out.

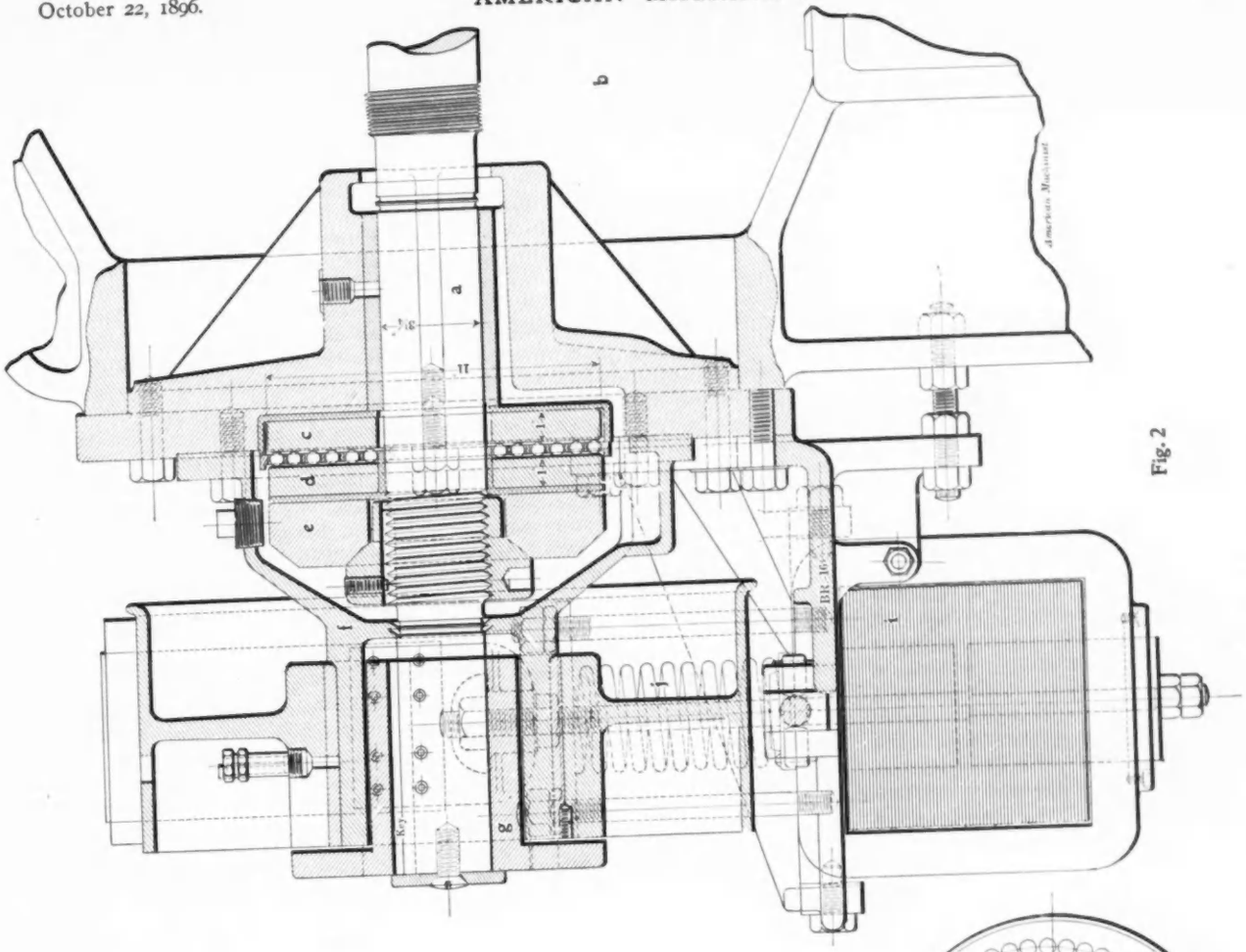


Fig. 2

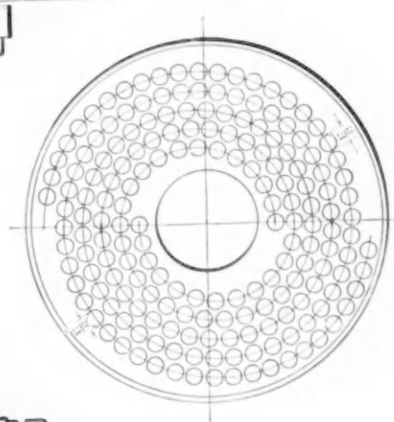

Fig. 3

BALL STEP BEARING AND MAGNETIC BRAKE OF THE SPRAGUE-PRATT ELECTRIC ELEVATOR.

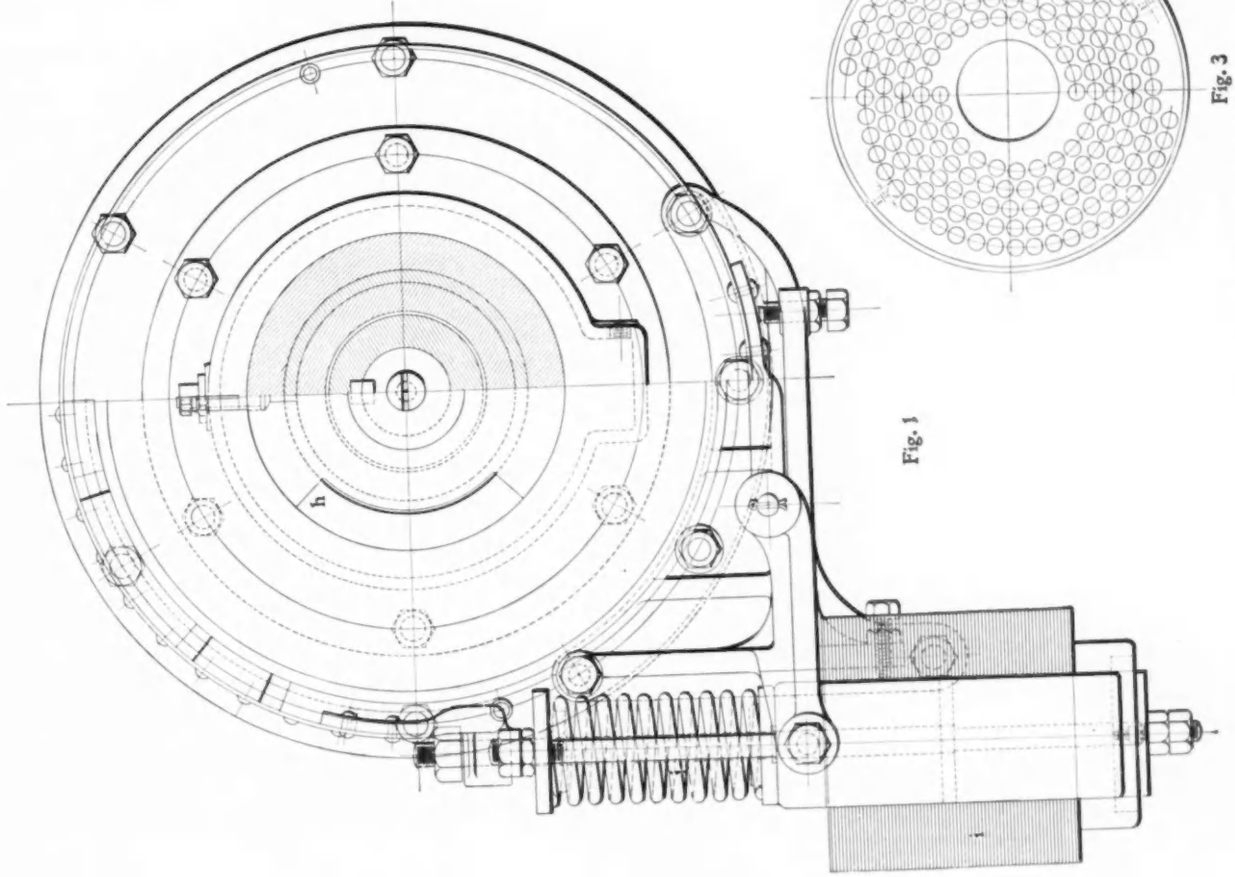


Fig. 1

# Letters from Practical Men.

## Hardening in Gas Furnaces.

Editor American Machinist:

In your issue of October 8th I find an article by Mr. F. L. Hubbard, replying to one by Mr. A. P. Press, on the utility of gas furnaces, contained in your issue of September 3d. Mr. Press so fully bears out my own experience—especially in regard to hardening large dies—that I feel bound to contradict Mr. Hubbard, in the interest of the craft of tool-makers in general, and the makers of large dies in particular.

I have used a gas blast "oven furnace" for over three years, for heating steel die blocks of great variety, some of them being as large as 12 inches long, 6 inches high, 8 inches wide, and, in fact, I have not found any of the difficulties enumerated by Mr. Hubbard, either as regards a "cracking of the firebox" or that "gas comes in contact with the steel and eats into it," or that "the air is too much in contact with the steel, which makes it spotted;" but, on the contrary, these things are decidedly prevented in a gas oven, such as I use, and I therefore must believe that Mr. Hubbard has never tried the kind of gas furnace suitable for his work.

I am led to believe that his experience has been obtained from a small "muffle" furnace containing a muffle with thin walls, the bottom of which cracked from overweighting it by a heavy piece. Such a muffle furnace excludes the products of combustion, the fire being entirely on the outside of the muffle, and the inside space heated by radiation from the walls only, and free air enters whenever the mouth of the muffle is open, thus producing oxidation; while in an oven furnace the gases are not excluded from the work, and being surcharged with free carbon by the admission of a sufficient preponderance of gas over air, oxidation is prevented, and the outside air cannot enter the heating space, because the atmosphere in the furnace under higher pressure excludes the outer air.

I have no doubt that Mr. Hubbard's experience justifies his statement; but it certainly has not been with the right kind of a furnace, which, like most tools, must be adapted to its purpose and correctly handled. As to even heating at the proper temperature, prevention of overheating and obtaining uniform results, I can only say that charcoal and coal are not "in it," and gas at even $1.50 per M. is a cheap fuel, which even at a higher price would offer decided advantages over old methods. I should be very much pleased to convince Mr. Hubbard by an ocular demonstration of the correctness of the position of Mr. A. P. Press and my own, and would be glad of an opportunity to harden any size of die blocks which my present oven will hold for Mr. Hubbard if he will be present when it is done.

GEO. F. CHAMPNEY.

Bridgeport.

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## Running Engines Without Cylinder Oil—Piston Rod Fastenings.

Editor American Machinist:

In a recent number of the "American Machinist" there was an article on the running of steam cylinders without oil. This is no new thing, as it was a common practice many years ago.

If oil is not put in a cylinder in the first place, it can be run indefinitely without oil. The only question is, Is it policy to do so? One thing is against it—it will cost more for coal than the saving in oil.

Locomotives of thirty years ago had ordinary unbalanced slide valves for throttle valves. The earlier ones used to have an oil cup in top of dome, so that oil—a tallow, that was used in those days—could be put in the steam pipe before steam was gotten up. In other cases, men learned, when the valve brought too much strain on the arm and back, to oil the cylinders, and then throw the lever over and pump some of this oil up under the throttle valve. Let a man handle one of those valves without oil, and then have it oiled without his knowing it, it was amusing to see him get braced for a strong pull, and then see him go over backwards as the valve opened so easily.

Forty to fifty years ago hundreds of Tuft's engines were turned out at Springfield, Mass. None of them that I ever heard of had an oil cup, or any hole of any kind by which any oil could be got into the cylinder, and the wearing surfaces were always as bright and smooth as could be desired. Other engine builders' practice was the same, and it was this class of engines that Mr. Corliss had to compete with, in many cases, when he used to put in engines and take his pay in the amount of coal he could save.

Take a slide valve engine with one port covered all the time, and the full friction on that end that must come from an unbalanced and unlubricated valve, and then take an engine that has the valve on one end only moved, and that unbalanced only when removing lap, the valve well lubricated, and you have an element of economy in fuel, aside from expansion and reduced clearance.

An engine with a disengaging cut-off would not work without oil unless the engine was heavily loaded so that the valve was well balanced, and the dash-pot had a long stroke so as to take hold good and strong, or else the valve was closed by steam pressure.

There may be instances where pumps and condensers and a surface condenser are all in evidence, that it might be the better plan not to use oil when everything is taken into account; but where there is friction on the valves, more coal will be used. With snap rings on the piston, and piston valves, it will be an easier problem; but the operating of steam cylinders without oil would be but reviving an old and abandoned practice.

The subject of fastenings for piston rods has been quite interesting. Some years ago I was very much opposed to screwed rods, and this aversion was intensified by having a screwed rod about 5 inches diameter break in the thread and let the piston go through the back end of cylinder, taking the head and cracking the end of the cylinder so as to require a new one.

Taking the jam nut, an excursion was made to the shop where the engine was built; but at a junction of the railroads it was required to wait an hour for a train that was behind time. When the train arrived, there was a broken cylinder head, a piston and keyed rod, the rod having broken in the key slot and the piston knocking out the head.

It was evident that it would not do to praise either practice.

In writing out specifications for three engines recently, I called for a keyed rod with fit turned straight. I had but a short time before had a little unpleasant experience with a tapered fit where the man got water in the cylinder, and the taper was shoved into the crosshead to stay.

There was one important difference between the locomotive and the two stationary engines. When the heads went out on the stationary engine, the cylinders were destroyed in both cases. The locomotives had the head and bolts made weak; the head and bolts broke, and all that was required new was a head, new bolts and rod. In stationary engine work, the heads and bolts are made so stout that the end of the cylinder is always destroyed. Here is a chance for the expression of ideas upon a topic fully as important as the piston-rod fit. If you don't have a good hold of the crosshead, you certainly want a weak cylinder head.

W. E. CRANE.

Waterbury, Conn.

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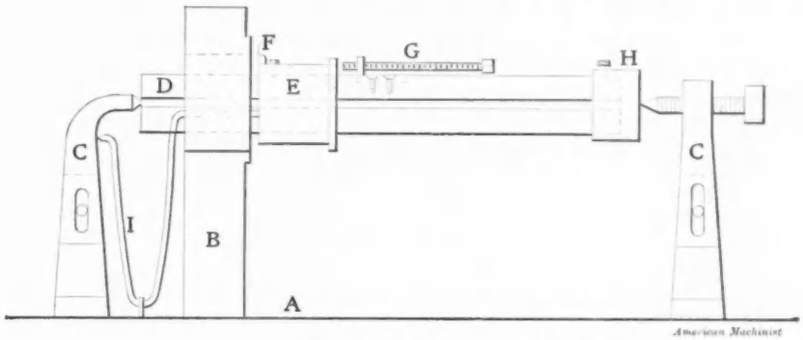
## Rig for Boring Taper Hole in Crank.

Editor American Machinist:

In answer to Question 163 by H. Bros, Pa., I herewith send sketch of small and cheap bar for boring taper pin hole in crank, which will do the work very nicely for them, as it has answered the purpose very well for me on several occasions. I have used different styles of bars for doing such work while in charge of jobbing shops, and have found this one useful around the shop where there was no regular traveling head boring bar, as you can bore any taper by simply making a slide for the end with centers, or by making different centers in the end of the bar or cap. The taper can be found very easily on a drawing board, or any place where a

few straight lines can be drawn the length of the bar.

In the sketch, *A* represents the frame of the engine, or any other suitable place to bolt or clamp the centers; *B*, the crank; *C*, centers with slot and tap hole; *D*, straight bar with keyway; *E*, sliding head with key and cutter, or tool; *F*, tool; *G*, feed screw to be turned with wrench; *H* is a cap which is used if the taper is too slight to permit drilling center close to center of bar; *I* is a spring of ⅜ or ½ inch round iron or steel, or in some cases a spiral spring can be used. The bar can be driven with pulley and belt, or a pair of clamps can be put on end and pulled by hand, as I have done more than once.




BORING TAPER CRANK PIN HOLE.

It will readily be seen that by drilling a center ¼ inch out of dead center you will get a taper of ½ inch in the length of the bar; that is, if the center is opposite the tool.

I hope this may help H. Bros., who seem to be in trouble where there is none that I can see, and that you will either publish this or send it to them direct.

JAS. T. FINK.

Washington, D. C.

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## Home-Made Rotary Shears.

Editor American Machinist:

A few years ago it fell to my lot to design a pair of rotary shears for shearing sheet iron into strips the full length of the sheet. These strips were riveted together and wound tightly on a narrow white metal pulley, to form the core of a gramme ring dynamo armature. After winding, the core was faced in a lathe, edgewise of the strips. This facing, together with the winding of the strips, makes it necessary to shear the strip considerably wider than its finished dimension, so that the more variation might be allowed in the rough width than otherwise. It was desired to quickly build the shears of such materials as could be readily obtained, and dispense with any castings or wrought parts necessitating pattern-making or elaborate forgings.

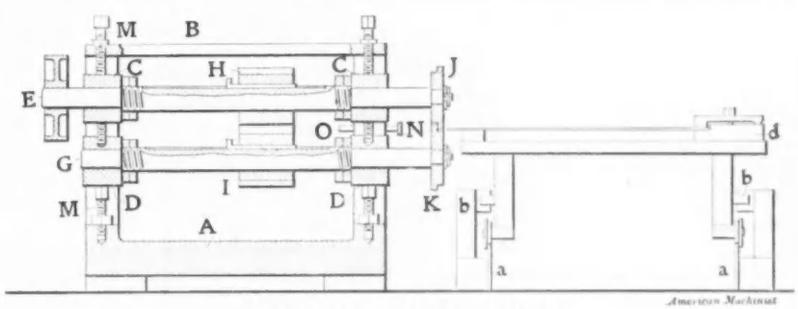
A casting *A* was taken from a Lincoln-head milling machine, with its strap *B* for tying the uprights. Bronze boxes *C*, *C* were bored larger; additional boxes *D*, *D* were duplicates of *C*, *C*. On the outer end of spindle *E* was keyed the driving pulley. With the exception of the pulley, shaft *G* was the same as shaft *E*. Shaft *G* was driven by shaft *E* through pinions *H* and *I*. These pinions were cut with involute teeth of coarse pitch. Cutters *J* and *K* were simply disks of tool steel, hardened and tempered. They were identically the same in dimensions, with cylindrical faces. Their circumferences overlapped so much that they could be sharpened continually by grinding. Threaded collars on the spindles gave lateral adjustment. Screws *M* held bearings *C*, *C* and *D*, *D* in proper relative positions and allowed of a slight adjustment. A stop guide *N* was carried by two graduating rods *O* sliding in holes in the uprights of the head, held fast by set screws. The graduation served to indicate the distance between the guide and the cut, or the width of the strip.

The carriage which held the sheet metal was similar to the carriage which holds the logs in a saw-mill; all movements were made by hand. Nearly all the carriage was carpenter work; it ran on rollers over tracks *a*, between adjustable guides *b*. The whole top *d* of the carriage was movable at right angles to the rails. On this top were clamps to hold the sheet metal fast. The movements of the carriage and its top were exactly those of a saw-mill carriage.

There is nothing novel or original in the whole arrangement, but the design fulfilled its requirements, viz., of using materials readily obtainable, and the tool was thoroughly efficient. I believe it is still in use, though it was constructed nearly seven years ago.

J. LANDSING.

99 Nassau st., New York.




HOME-MADE ROTARY SHEARS.

## Home-Made Shop Tools.

Editor American Machinist:

Mr. Arnold's interesting description of the De La Vergne cylinder boring mill set me thinking again, and I hope he will not be offended on that account. Of course, the mill that he describes is interesting from its mere size, as well as in the details of its construction. I had to do with the building of a cylinder-boring mill in my very earliest days in the shop; I did the looking-on. The mill never got into the papers, and has probably never been even mentioned in one until this moment. It would bore cylinders (blowing cylinders) up to 6 feet in diameter and 8 feet long, and for its day, in the early fifties, and in an isolated country shop, I cannot but think that it was quite as much of an achievement as the one that Mr. Arnold describes.

As with the De La Vergne cylinder borer, only more so, the mill was built without drawings. There were, in fact, no drawings used in the shop, unless an outsider brought in a job with drawings, and there was scarcely a scrap of paper in the whole shop as a visible record of work done and how it was done. When sketches were very necessary, the customary way was to get a planed board and cover it with chalk, and then to pencil out what was wanted. A number of very good steam engines were built in the shop with no more drawing than that, and the shop made considerable money.

The boring mill was entirely self-contained; and for this kind of work, when you have a good base or foundation plate, the rest of the structure need not be brutally heavy. The bottom casting was a cross with four equal flat arms of good thickness, a large central hub for the step, and radial ribs to stiffen the plates. Then there were four columns and a lighter cross on top, with a hole big enough for the 12-inch bar to slip through. The bearings or guide for the top of the bar consisted of four gibs set up with a set screw at the top and bottom of each. The bar was driven by a big worm gear keyed to the top of it, and the feed was by gearing, instead of the star feed, which is all right enough, I suppose, but which it seems queer to use for a deliberately built modern tool. The feed screw was right-handed, 6 threads to the inch, and ran

down a large groove in one side of the bar. The top of the screw was made to take a change gear from one of the lathes, for we had such gears on three or four lathes. Then another change gear was fastened to a stationary spindle in the center. The lower end of the spindle went down a couple of inches into a bored hole in the top of the bar, and the upper end of the spindle, above the gear, was held from turning by a light arm that reached in over the big worm gear. These two gears would be selected to give the right feed, and then an intermediate gear attached to the top of the bar was set to connect them. With a very small gear in the center and quite a large one on the screw, a fine enough feed for the first cut was got without any trouble, and for the finishing cut the gears were changed for a coarser feed. I think four cutters were used, and for the finishing cut a lot of hardwood rubbing blocks were fitted in eight dovetailed seats cast around the head.

The blowing cylinders that we used to bore were cast with a flange at each end, and on the upper end of the casting there was a riser six or eight inches above the flange, the riser corresponding to the body of the cylinder and leaving the flange projecting at the side. The cylinder was set in the boring mill with the riser end down, the flange resting on four iron blocks and strapped to them. The upper part of the cylinder was steadied by four braces reaching to the pillars. The interesting part of the whole job was after the cylinder was bored, and I had to get in and ride around on the boring head, and cut off the riser by feeding out the cutting tool with a little tap of a hammer at each revolution. There I would be stuck for three or four hours, with nobody within call, and imagining all sorts of things that might happen if the tool should catch and knock the cylinder off the stocks. I do not think I have had many situations that have tried my nerves more severely.

Tools of this character it seems to be quite proper to have home-made, because they can scarcely be said to be standard articles, and there is no reason why the De La Vergne Company should not have suited themselves as well, and have built the mill as cheaply, as any other firm could have built it for them. There is, however, always something to be said against the building of these home-made tools without drawings—at least as long as people will continue to do it. The practice certainly never pays. Good drawings are always money-savers. They not only secure cheaper construction, especially by preventing mistakes that entail the making of parts over again, and the delay of waiting for one part before another is made, but the machine must be inevitably better if it can be seen in all its components, and thought over, and talked about and made a subject of suggestion before it is immutably embodied in iron and steel.

About the cost of these home-made tools there is often a wrong impression. I confess that to quite an extent I believe in making many things that it is quite possible to buy, not lathes or planers, or any of the standard tools, but many other things that are good to have and which will not be secured unless they are so made. It is the exception rather than the rule that any shop is able to employ all its men all the time to the best advantage. There come many odd times when something to fill in comes very handy even to the best of managers, and without what you might call slack times, and even slack times may often be profitably bridged over by improving the shop equipment. Good men are retained that it would be a misfortune to lose, and the executive ability of the establishment is elevated rather than impaired. It is quite a point, often, to be able to give a bright boy a chance at a little variety of work that he could not have in the regular routine work of the shop.

In this view of it, the costs of such tools are not to be scrutinized too closely. Even if they cost as much as they can be bought for, and they don't generally cost more, no money is lost, and everybody and everything is the better for it.

TECUMSEH SWIFT.

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## Backing Off Reamers.

Editor American Machinist:

Your correspondent, Mr. T. R. Almond, some time ago gave us on this subject volumes of good practical common sense. My experience with reamers, especially hand or sizing reamers, agrees with his.

I have heard advocated more than a few schemes as preventives for "chattering," notably, that the flutes be cut irregularly, in order that the cuts, if inclined to jump in, will not do so. They are not exactly opposite to each other. That is what they say; but, Mr. Editor, I have seen that kind of differential fluting chatter in spite of almost every effort to prevent it. Does it occur to these differential theorists just what causes a fluted reamer to fail to ream smooth? We hear of commercial reamers whose cutting edges are "patent relieved," etc., etc., and I have seen some of this kind that were as prone to chatter, or to cut out a many-sided hole rather than a round smooth hole, as the sparks are prone to fly upward.

Mr. Almond's method is just the very best thing to do to prevent chattering. Besides, as he shows, the reamer being carefully ground round and true, with practically no backing-off of teeth and finish reaming taking out a very small amount of stock, will keep the reamer up to size very much longer than where teeth of reamer are backed off; and, as he tells us, when the reamer gets dull, just take it to the emery wheel suited to get into the flute and it is good for another term of service, up to size remaining.

Years ago I worked for ——— in ———; he had a good lot of reamers, supposed to be correctly made up. Of course, some sizes were used very much more than others, and justly, perhaps, were later nicknamed "burnishers." One day a job came which lasted some time, and among tools used, or to be used, was a 5/8-inch hand reamer. It was a smooth, round, dull fellow, and the boss had about made up his mind to buy a new one. I took that reamer down to the emery wheel, re-edged it as Mr. Almond prescribes, and brought it back and asked my worthy chief to try it. He did so—and, to the joy of his heart, the old burnisher was again a new, sharp reamer, so near up to size as to be practically correct.

No, Mr. Editor, this "patent relieved" business is not good for the reamer nor for the man who buys it. Quite likely the concerns who make to sell may get more reamers to make and sell on account of so very narrow limit of up to size to stand the wear, so that they very soon get below size.

I once worked for one "bang up" machine concern who made their own reamers, and after being carefully ground, they were carefully honed on outside back of tooth face to fit a ring gage. They did some fine work, and lots of it. Those reamers were cut with *regular* divided teeth and could not chatter; they reamed smooth holes and never anything but round holes.

One of the chief causes of vibration, or its effects, is too much rake of any cutting tool. Just the same with a reamer with too much backed off from face of teeth, and an irregular division of flutes does not remedy the incorrectness of cut—simply chatters finer; that is all.

I hope Mr. Almond will give us some more of the same sort from practical experience.

FRANCIS W. CLOUGH.

Springfield, Mass.

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## Shade Lines on Working Drawings.

Editor American Machinist:

The controversy respecting the propriety of shade lines has interested me greatly, and some of the charges brought against them impel me to rise in their defense.

While I cannot boast of as many years on earth as some of the brethren, perhaps my experience with drawings, both in the shop, the school and the patent business, besides that in the drawing room, is by no means meagre, covering a period of nearly ten years.

A couple of years ago it was my pleasure to observe a sort of competitive test between shaded and unshaded drawings. A

set of tracings was made by an inexperienced engineering student, of a moderately complicated machine. There was not a shaded line on them, though they were neat, accurate and well-figured. The day they were put into the shop they made trouble; the men seemed at a loss to know how to read them properly, requiring the continual advice of the foreman and superintendent, who, after a time, ordered an entirely new set made with the lines shaded. No more of this particular machine was made for some eight months between the withdrawal of the first drawings and the institution of the new, as the shop had been closed during that period, and when it reopened there were many new faces. The second set caused no trouble whatever, though the only alteration made was in the addition of shade lines. The old men were aware of the change in the drawings, but many of them did not seem to know wherein they differed, except that they "stood out and looked more like real things," as some of them remarked.

From this, does it not seem that the shade line is an important aid to the ready comprehension of a drawing? And is it not also true that the things which exert the greatest influence upon our minds are those little things which we unconsciously, unthinkingly, though instinctively, observe. There is fully as much difference between the shaded and unshaded drawing as there is between the poster girl and the real article.

From my own experience in working from them, I know I can read a shaded drawing in one-third the time of the unshaded variety, and with much less effort and its consequent fatigue.

The extra expense involved in the execution of a drawing with shade lines is fully compensated by the time saved in the shops, which brings the economical factor just where it will do the most good.

The scaling of drawings is looked upon with disfavor by many engineers, and some of them go to some length to prevent it. Personally, I do not wholly approve of it, though in many instances one can hardly do otherwise than sanction the practice. A drawing in which the width of an ordinarily heavy line will constitute a serious error when scaled, is not properly figured, which is as good as saying that the employer will do well to investigate the capability of his draftsman.

I am not an advocate of wholesale dimensioning, but believe in a conservative, systematic, but thorough practice in that particular, for as everyone knows, too many figures will soon render unintelligible the clearest of drawings.

To sum up: The drawing room is the poorest place in a plant in which to practice rigid economy. Extravagance anywhere is disastrous, but no more so than cheap job-lot draftsmen, which seems to be a prevalent disease just now in some of our manufacturing institutions, as the subject-matter of several communications to your paper tends to show.

FIDEI DEFENSOR.

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## Compressed-Air Surface Cars in New York.

As our readers are already informed, a practical exhibition of the compressed-air motor for street cars has been going on in this city since August 3d. In view of the results accomplished, we can scarcely speak of the exhibition as in any sense a trial or an experiment. The Third Avenue Railroad is a finely-equipped and well-operated cable line. The portion of it that is known as the Fort Lee route is a crosstown line extending from the North River to the East river, the length of the round trip being 4⅜ miles. Two cars of the American Air Power Company commenced running on this line on the date mentioned, sandwiched in at their proper intervals between the cable cars of the same line, and taking the full service of two regular cars. The cars have run continuously and are still running, not only without accident, but without incident. The greatest thing of all that can be said of them is that there is nothing to say. To those who are familiar with the history and development of the street-car service, and to mechanics who have seen the trials of mechanical devices of any kind, even those ultimately the most successful, the record of these cars thus far is unique and absolutely unparalleled.

A representative of the "American Machinist" recently purposely saw the authorities of the Third Avenue Railroad Company, and they stated to him, through Mr. Robertson, the general superintendent, that the running of the cars has been entirely satisfactory to the company, and evidently also to the public, as the cars have been patronized without apparently the least discrimination, and not the slightest remark has been heard from any passenger other than in full approval of them.

We have more than once taken one of those cars, and gone over the line as an independent and unnoticed passenger, and watched their operation. As to the running of the cars, it is difficult to offer any remark, as there is no prominently noticeable feature. They run smoothly, and both stop and start without jerk. The motorman handles the car with greater ease than with any other car that we have ever seen. No muscular exertion is required, as with the grip of the cable car, and no violent movements, as with the brake of the trolley car. The possibilities of the brake seem to be completely appropriated, as it is instantly applied, and, if necessary, to the full and most effective pressure of it, and it is simply absurd to say that at the present moment any better brake for surface cars is known.

Careful record of every detail connected with the running of the cars has been kept from the beginning, and the actual air consumption is quite accurately known, and consequently the ultimate power economy of the system; but we are not at present at liberty to give any figures upon this point. We are assured, however, that the results are highly satisfactory. The cost of air compression is well known. Builders of air compressors stand ready to give the most binding guarantees to furnish a compressing plant that will compress so much air for so much coal consumed, so that in the present demonstration it was not considered necessary to seek perfection or economy at the compressing end of the plant. The compressed air is always ready for the car as it is wanted, and that is all that has been attempted.

The compressing plant employed in this case is a cheap and temporary one. Two second-hand locomotive boilers supply the steam. One is a discarded boiler from an elevated railroad locomotive, and the other is something similar. The compressor was built by the Norwalk Iron Works and does its work satisfactorily, and it is not the least reproach to the builders that it is not of the highest type of steam compressor, as they would, of course, have been glad to build a better machine for more money. A duplicate of this compressor is installed, but one of them is more than sufficient for the requirements. The steam cylinder of the compressor is 16 inches diameter and 16 inches stroke. The first air cylinder is 10½ x 16 inches, double-acting; the second cylinder is 6¼ inches diameter, and the third and last cylinder is 2⅝ inches diameter, both of these being single-acting. The air between each cylinder and the succeeding one is cooled to very near the normal temperature. After leaving the last compressing cylinder, the air is cooled by traversing a long water-jacketed pipe, and then is passed through a coil of copper pipe in a large tank of water. Just beyond the coil, the air, before entering the storing reservoirs, passes a chamber where it deposits most of the water that it had contained. About five gallons of water per day are here dropped by the air, the quantity varying considerably from day to day with the atmospheric humidity.

The storage reservoir consists of a group of thirty Mannesman tubes, 9 inches diameter and 21 feet long. As the air is compressed to 2,500 pounds, while the car only carries 2,000 pounds, the difference in these pressures is enough to always provide a full supply of air for one car in the storage reservoir without waiting for the compressor. The tubes, both in the storage reservoir and on the cars, are hemispherical at one end and drawn down to a bottle neck at the other end where the connection is made. A bent copper pipe is used for each connection, so that all strains from changes of temperature or other causes are avoided. The valves and pipes are so arranged that the receivers, in sections of ten each,

may be disconnected without interrupting the service of the others.

The car is operated by two cylinders 7 inches diameter by 16 inches stroke. They are placed horizontal and considerably above the axles. A connection from the crosshead attaches to a vertical rocker arm, and another connection from this rocker goes to the crank on the axle, side rods connecting the two axles. The air is used at from 100 to 150 pounds pressure, and before entering the cylinder is passed through a tank of hot water, where it is heated to 300 degrees, the heat and the vapor taken up contributing considerably to the economy of operation. The air is used expansively in the cylinder, and the exhaust is absolutely noiseless and undiscoverable. The cars regularly make three round trips, or over 13 miles, upon a single charge, and upon more than one occasion have made four trips, or 17½ miles.

What may be regarded as a still more important exhibition of compressed air for traction purposes is soon to be made on the Manhattan Elevated Railroad, in this city. A compressed air locomotive will take the place of one of the steam locomotives on the road, and haul a regular train. The compressor for this service will be a Corliss compound steam engine with four-stage air compression, and from the coal pile to the passenger a high power economy may be expected to be obtained. Both motor and compressor are being pushed rapidly to completion.

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## Citizenship and Technical Education.

An interesting and stimulating address was delivered at Lehigh University on Founder's Day, October 8, 1896, by Mr. J. H. Converse, of the Baldwin Locomotive Works, Philadelphia. The address was a plea for an all-round or general education rather than for a narrowly technical one. We have space only for one or two extracts:

"The maxim that 'every man is the architect of his own fortune' is only true in a qualified sense. Every man is indebted to the contributions of his predecessors and his contemporaries. The chemist who has determined the properties of matter, the engineer who has shown in practice structural possibilities and principles, the architect who has enriched the world for generations to come by a creation which is a 'thing of beauty and a joy forever,' the metallurgist who has developed methods of manufacture which have enhanced and extended the usefulness of the materials at men's command—all these have contributed to the common stock of human knowledge, and have made their successors or their associates their debtors. Herein is true socialism—that socialism which grows out of the constitution of society ordained by Divine wisdom. It is not the creation of arbitrary law, but demonstrates anew the universal brotherhood of the race in the dependence of one on another, and in the indebtedness which every successful man incurs to his fellows. Every mill or manufactory, every coal mine, every productive enterprise which dots this teeming Lehigh Valley, and has made it and its workers what they are, is the concentration of the unbought but priceless experience of thousands of thinkers and workers who have gone before. How better can you or I, if we have profited by their labors, repay our debt than by passing on to our successors the opportunities for training which shall be the means of further progress?"

* * * *

The speaker advocated a university course of five or six years, the first three of which were to be devoted to general subjects, or to the elements of what we call a "liberal" education.

"At the end of the three years' course the university might give and encourage a year's leave of absence, during which period the young man might obtain employment in a machine shop or factory and obtain some practical training in the use of tools and machinery. Much could be accomplished even in that brief time, and I venture to assert that there are many manufacturers in the United States who would heartily co-operate in such a scheme. The young man, after a year or fifteen months' practical work, would enter upon the scientific studies in mechanical engineering with a higher appreciation of their value, with a more intelligent comprehension of their application, and with greater ability to assimilate the theoretical principles of the text books. It is a well-known fact that the best draughtsmen (and I use the term not for mere copyists, but for designers) are those who have had shop practice. They have learned what tools can do, and by what process results can be reached most economically and effectively. I need not extend the illustration. You will at once apply it to the case of the civil engineer, the engineer of mines, the chemist and the architect.

"The young man who has thus taken the complete course of five or six years will, when he finally receives his engineering degree, be entitled to stand as a thoroughly educated engineer. His culture will have been broad and liberal. He will be equipped for the highest citizenship, and can stand as a peer of any in the community. There are few professions where the widest knowledge can more fully be utilized than in that of the engineer. No man, whatever his calling, can know too much. He will find use in the most unexpected manner for attainments apparently foreign to his pursuits. The engineer, of all men, must be a practical man, a man of business. He must be able to write concisely and vigorously. If he possesses the faculty of a public speaker, it will come in play. His knowledge of business forms and methods should be complete and exact. He should be a bookkeeper, a banker, a manufacturer, a merchant. Something at least in all these pursuits may fall to his lot in the varied conditions of his professional life. All these attainments, and more, can be utilized if he is to fulfill the definition of an engineer which I have already quoted, as one capable of 'directing the great sources of power in nature for the use and convenience of man.'

"The young man successfully completing such a course as I have outlined has not only the liberal education which makes the man, but has also a profession or calling at his command. Uncertainty as to his future is measurably removed. He is ready to enter at once upon his life work. The contrast is marked between his case and that of the newly graduated Bachelor of Arts of a classical or literary curriculum. The latter finds himself, not infrequently, not only with no equipment for a life work, but uncertain as to what to undertake. In many cases he is at a disadvantage compared with the boy of 17 who has had less education, but more practical experience. But the graduate of the ideal university which I have attempted to picture will be at no such disadvantage. He will be ready to take his place as a useful member of society and faithfully to discharge the duties involved in the truest citizenship."

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"The interests of manufacturing and commerce have little respect for the dignity of science. Their motto is that 'nothing succeeds but success.' The practical man, who knows thoroughly a few things, is considered superior to the theorist, who has a partial knowledge of a variety of subjects. The graduate must, therefore, be ready to subordinate his training to the necessities of business. He will, undoubtedly, in good time, find ample opportunity to use all his acquirements; but he must be content, in entering on his work, to accept conditions as he finds them, and to wait patiently for an opportunity to utilize his knowledge. There is one term too commonly used which is mischievous in its influence. We hear of a young man seeking a 'position' in a business. It is not 'position,' but opportunity of usefulness that should be sought. Faithful and intelligent service will generally secure recognition in the long run. A young man of my acquaintance, who had completed his course as an electrical engineer, sought employment with the Westinghouse Electrical Company. The first work to which he was assigned consisted in trueing up by hand the plates of an armature and covering it with asbestos, a process which, perhaps, could have been as well done by an ordinary laborer. The manager grimly remarked that such a job was what they usually assigned to college graduates. The young man accepted the task without a murmur, and in no long time was promoted to more

important and congenial duties. Another case within my knowledge is that of a young man who had received his degree as a mining engineer. He learned that a certain smelting works in one of the Western States had applied to the president of his institution for some one to serve as helper in the assay department. The salary was inconsiderable, but the place was accepted, and within one year he had been promoted by successive steps until he was offered an engagement as manager of the works. One more instance will suffice.

"At the commencement exercises of 1895 of my own Alma Mater, a young man, just graduated as a mechanical engineer, applied to me for employment. It was arranged, and, on September 1st, he reported for duty and was assigned to work in running a shaping machine in a night gang. Several promotions were secured in a reasonable time, and, in May last, an application which was received from the Government of the United States of Colombia for a principal instructor in a mechanical school in that country was filled by the nomination, by his employers, of the young man referred to. I have every reason to believe that he is satisfactorily and successfully discharging the duties assigned him."

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## The Machinery Exhibit at the American Institute Fair.

A true and well-equipped modern mechanic should be interested in everything, and generally know something about it and want to know more, so that the exhibit at the American Institute Fair, now about closing in this city, could hardly fail to touch him at many points. If, however, he went there looking for things distinctly mechanical, he could hardly fail to feel more or less disappointed at the meagerness of the display.

The running machinery in "Machinery Hall," in the basement of Madison Square Garden, not more than one-third of the available space of which was occupied, was driven by a 12 x 13-inch Weston engine, which would compare favorably in every respect with any known engines of the same class. The only other steam engine on exhibition was the Vogel engine, exhibited by the inventor, Charles Vogel, Fort Lee, N. J. This engine consists of three inverted single-acting cylinders connected to a three-throw crank. The steam distribution for all the cylinders is accomplished by a single circular valve revolving at one-half the speed of the crank shaft. A certain amount of cut-off is accomplished by the lap of the valve, and the engine is instantly reversed, without shutting off the steam, by simply running the valve ahead by means of a hand-wheel until it fetches up against a stop which will drive it the other way when the shaft is reversed. The engine runs very smoothly and can be run at a high speed. One of these engines was shown driving a propeller wheel in a tank of water with glass sides like an aquarium.

The Watson-Stillman Company had an excellent and very full exhibit of their specialties of manufacture, comprising hydraulic presses, jacks, pumps and a great variety of hydraulic leathers for pumps and rams, from the smallest sizes up to 18 inches diameter. A power-driven broaching press was shown in operation, the power being employed to work the pumps, and the machine being entirely self-contained.

A full line of emery-wheel grinding and polishing machinery, made by the Standard Machine Company, Holyoke, Mass., was exhibited by The Law Company, 121 Liberty street, N. Y.

The above two exhibits had something of a machine-shop flavor, but other than these no machine tool of any kind was exhibited.

The Dodge Manufacturing Company showed a variety of their well-known wood split pulleys, split friction clutches, hangers, etc.

The Otto Gas Engine Company showed several stationary engines, one driving a light dynamo; also one or two of their gasoline engines for launches.

The Daimler motor was very fully exhibited on the main floor, in all its varieties for marine, stationary and road use, and the American Gas & Power Company showed one of their well-known naphtha launches.

Printing presses were the only line of running machinery exhibited in any variety, and of these there were several in operation; one shown by the Campbell Printing Press & Manufacturing Company, said to be running to make a record for a day's work. The most interesting press, to us, was a little automatic card and envelope press made by the Harris Press Company, Niles, O. This press ran very fast, fed itself, taking the cards or envelopes from the bottom of a pile and stopping automatically, so that the blanket would not be inked if the feed missed or when the supply gave out.

For exhibition purposes the little electric motor for each machine is a great improvement on the line shafts and belting heretofore so necessary, and all the machinery shown on the main floor was driven by this means.

Of the exhibition, as a whole, it is not our purpose, nor perhaps our province, to speak. It is perhaps a fact that the American Institute attempts to cover too much in these exhibitions, and that exhibitors have a feeling that no single line can be adequately represented, and that it is therefore futile to attempt it. It is certainly anomalous that the bicycle show alone can make double the spread that is made by the American Institute Fair.

## The Indiana in a Heavy Sea.

Quite a lively time was experienced on board the battleship Indiana when, with the other vessels of the White Squadron, she encountered the recent heavy weather off the coast. Soon after leaving Hampton Roads high winds and heavy seas caused the Indiana to roll badly, the inclination at times reaching 36 degrees, and the clamps or locking devices for the turrets proved unable to hold them. The ship has four turrets carrying 8-inch guns and two 13-inch gun turrets, which, when not in action, are secured by clamps. With the ship rolling in a heavy sea, the strain upon these fastenings is, of course, enormous, the long, projecting muzzles having a powerful leverage, and, in fact, nearly the entire weight of the guns being outside the center of the turret. But however great the strain, it should be easy enough to compute it, not difficult to devise adequate fastenings, and not impossible to know with certainty that they were either sufficient or insufficient.

Soon after leaving Hampton Roads, all four of the 8-inch turrets broke loose at once, about 2 P. M. The course of the ship was changed, and, after many hours of hard and dangerous work, the turrets were secured by lashing the muzzles of the guns of adjacent turrets together. In the middle of the night two of these got loose again, and then the forward 13-inch turret guns began swinging around with their turret, threatening to demolish the entire superstructure. Hawsers thrown about the muzzle were snapped like twine. A 5-inch wire cable was tried, and 100 fathoms of it went overboard, threatening to foul the propeller, and everything had to be stopped to recover that. The guns were finally caught and secured by an 8-inch hawser, and fastened to the superstructure. The trouble lasted until daylight. It is estimated that three weeks will be required to get the new fastenings applied. We do not hear that there was any trouble with the running or handling of the engines during these occurrences.

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A sample warehouse, for exhibiting American products of various kinds, is to be opened at Caracas, Venezuela, under the auspices of the National Association of Manufacturers of the United States. The concession obtained from the Venezuelan Government permits the entry of goods for exhibit free of duty, with the dues to be paid only in case of actual sale. The association, with its headquarters at 1751 North Fourth street, Philadelphia, issues a circular of information describing the building proposed for the permanent exhibition, with a plan of the spaces allotted for goods; and this circular also briefly sets forth the population, area and products of Venezuela, and the possibilities of trade with that country.

# American Machinist.

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*We invite correspondence on subjects pertaining to machinery.*
*Name and address must always be given, though not necessarily published.*
*Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.*
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## The Mechanical Engineer and the Future Development of Rapid Transit.

The problem of urban and suburban rapid transit, although a peculiarly urgent one for New York, and especially for The Greater New York, is one of constantly increasing interest and importance for every large and growing city. The problem is by no means a simple one; the factors involved are not only numerous, but many of them quite indeterminate, and to a large extent dependent upon the personal equation of whoever may attempt to assist at a solution. The conditions are also rapidly changing, and especially as to the future means for the accomplishment of the ends desired. While this change in available means is in progress, that community is to be congratulated which finds itself still free to choose and to adopt the latest and best. It is a misfortune to-day for a city to be involved in heavy expenses for constructions or installations which, in the light of present developments, it would be glad to recall and redesign.

Popular predilections and the tendencies of mechanical invention seem to-day to be pointing quite plainly in the same direction as to the future development of rapid transit in our cities and their suburbs. Other things being equal, or even nearly equal, the indications are quite clear that the people prefer surface roads to either elevated or underground roads. New York City, as is well known, is long and narrow, and means of rapid transit employed in the city must be developed in directions north and south almost exclusively. Four lines of elevated roads in these directions, which have been in full operation for a dozen years and more, have done wonders in promoting the rapid upbuilding of uptown New York and the surburbs beyond. But within a year or two a great change has taken place. The city has seen the completion of two cable roads, one upon the same avenue with the principal elevated line, the other upon Broadway and then branching off to the avenue traversed by the other principal elevated line. The immediate result has been that travel has fallen off quite visibly from all the elevated roads, while each cable road has developed an enormous and still rapidly growing traffic.

The conditions that have operated upon the minds of the individuals who compose "the public," and led to the choice of the cable or surface roads in preference to the familiar elevated roads, have, of course, been various. A management too evidently indifferent to the comfort and convenience of passengers on the one side, and an endeavor to conciliate and attract on the other, have had some weight; but the most powerful and operative conditions have been the essential differences in the systems.

The surface-road passenger has no station to seek (often three or four blocks up or down the line), no stairs to climb, no delay in buying tickets, no waiting a minute or two or five for a train, and at the other end also no stairs, a stoppage and alighting at the nearest point to destination, and all along the way usually something more or less of interest to be seen in the street. The system of transfers to crossing or connecting lines, now so general in all our cities, while always fully available to the surface-car passenger, can never have more than a limited application to elevated-road service.

All the advantages which the surface car has to the passenger in comparison with an elevated train must be still more pronounced over any underground system. The depressing monotony of the trip, and the apparent lengthening of it by lack of incident, must make such a road only acceptable as an unavoidable necessity. It is difficult to believe that an underground road could ever be acceptable to the general public as a means of daily conveyance between the business and the residence sections of any city.

But now we are brought in sight of still other possibilities. Who is to say that even the surface railroad is not also to be largely superseded for local traffic? What, in fact, is there that will guarantee the continual prevalence of the surface railroad in our large cities, or where in the near future will be the excuse for their existence? The reason for the original building of the surface railroad was obvious enough. As a successor of the omnibus, slowly but rattlingly and noisily dragging its miserable load over the stones, it was a great success. The car would carry four times the passengers doubly as fast, and with more than four times the comfort and convenience possible with the old omnibus, and there was never any contest or comparison possible between them.

But it seems now to be quite evident that the day of the omnibus is coming again. The line of rails has of late years been an imperative necessity with any system of passenger conveyance, on account of the saving of power and the smooth running thereby secured, and the possibility of applying mechanical means of traction. But to-day, independent motors, ball-bearings, pneumatic tires and asphalt pavements, all combined, will enable vehicles to be propelled as cheaply without a line of rails as with it, and then the only thing remaining to the surface railroad is the right of way, which the line of rails more or less guarantees and secures.

The right of way can be arranged for and secured as well without the rails as with them, and the removal of the rails from our streets will be the abatement of what is in itself a very objectionable feature. The motor omnibus, supposing it to have all the qualities which we assume for it, of easy draft or propulsion, smooth running, perfect control and any permissible speed, will have a great advantage over the rail lines in choice of route and in the collection and distribution of passengers at either end. The obstructions and stoppages to which the street car is most subject, on account of loaded wagons choosing the smooth-running tracks, would disappear of itself, as there would no longer be the strong temptation that now exists for the one to interfere with the other.

This is the day of the independent motor, and probably more for the general use of the public than for the individual. As to which is the motor, whether steam or compressed air, or the oil engine, the storage battery, or some other, no one need attempt to say. The mechanical engineer and the inventor have brought great possibilities into view, and we cannot doubt their full realization. The movement looking to the extensive adoption of motor omnibuses in Paris and London is only a sign of the times, and it is to be hoped that we will not be left far in the rear in our recognition and acceptance of the inevitable.

General, rapid and comfortable conveyance is largely dependent upon smooth roads, and there are so many considerations combining to render them desirable that they can scarcely be urged too strongly. They are the key to cleanliness and health in cities, as well as to rapid

transit, and either consideration should be sufficient to insure their universal adoption.

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In our issue of March 12, 1891, we remarked upon the advanced methods employed in launching the then new daily paper, "The Recorder," in New York. It was said that $300,000 was spent upon it before the paper was submitted to the public, several complete editions having been gotten out as a preparation for public appearance. The paper suspended publication recently, after having sunk for its various proprietors several moderate-sized fortunes, thus demonstrating again that there are some things which money cannot accomplish alone.

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# Questions and Answers.

**Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.**

(182) B. Anderson, Ind., asks: 1. How do draftsmen describe circles 1-16 to ¼ inch and small curves with a drawing pen, without making ragged lines? My compasses will not do it. A.—This is largely a matter of skill and practice, but it is greatly facilitated, of course, by having proper instruments, and for striking small circles a small bow pen should be used. These you will find illustrated and described in the catalogs of makers of such instruments. 2. When you get a vacuum of 15 pounds and keep on pumping, what takes place. It seems to me that you ought to get more vacuum, and I have puzzled over this question a long time. A.—Your difficulty seems to come from a failure to understand clearly just what a vacuum means. It actually means nothing, and when you have, by pumping, obtained a space in which nothing exists, then you cannot pump anything out of that space; and though the pump may keep on going through its usual motions, there will be nothing to lift the valves from their seats, and no more complete or perfect vacuum can be obtained.

(183) J. T., Elgin, Ill., asks: Will a lower temperature result from the free discharge of compressed air into a coil of pipe or a chamber, as the interior of an ice box or refrigerator? "I am of the opinion that the air must expand, doing work, as in a cylinder with a piston, to produce the cold. In my experience I have seen the compressed air used in the same manner as steam in an expansion cylinder, assisting to compress the air in the compression cylinder, the exhaust from the expansion cylinder going to the cooling room or refrigerator." A.—The fall of temperature is an inevitable accompaniment of the fall of pressure and increase of volume. Where the air can be used for power as well as for refrigeration, it is, of course, desirable and economical to do so, the doing of the work also contributing slightly to lower the temperature. In the case of an engine of considerable size, the freedom of the passage to the exhaust is also an important and helping feature. If air is discharged in small quantities through a throttled or restricted passage, the friction of the air through the passage will cause the discharged air to have a higher temperature than it would have if the discharge were freer; but its temperature will still be considerably lower than before its re-expansion.

(184) S. G. W., Milwaukee, Wis., sends us the following questions, with the remark that they are so queerly worded that he cannot understand them, so that they seem to have originated with some other person: 1. Should the bucket valve of the air pump break, what effect would it have on the engines? A.—The immediate effect would be an increase of back pressure, which increase would continue until the pressure became somewhat above that of the atmosphere, when the exhaust would blow up through the air pump. 2. What should be the temperature of the water in the hot well with the injection water at 60 degrees, and how do you get at it by calculation? A.—Not only the temperature of the injection water, but also the quantity is to be taken into account. It is usual to allow for the injection water about 27 to 30 times the weight of the steam, and then the temperature of the hot well should not be above 120 degrees. 3. In what condition should a steam engine be when the main valves are adjusted? A.—All other connections and parts should be properly adjusted, and for the final adjustment of the valves the parts of the engine should be at normal temperature, or the engine should have been thoroughly warmed up by the steam. 4. How may the evil effects of excessive clearance be lessened? A.—What are the evil effects, and where is the line drawn between clearance and excessive clearance? In some sense, is not all clearance excessive?

(185) P. C., Pittsburg, Pa., asks: 1. How many pipes of a smaller diameter will it take to give the same volume under the same head as a pipe of larger diameter? A.—The sectional areas of pipes are directly as the squares of their diameters, so that $\frac{D^2}{d^2}$ will give the number of pipes of the smaller diameter that will equal the larger one in area. In the above, $D$ is the diameter of the larger pipe, and $d$ is the diameter of the smaller one. If the larger pipe is 10 inches diameter, and the smaller pipe is 5 inches diameter, then $10^2 \div 5^2 = 4$, the number of pipes of equal area. The larger pipe would still have considerable advantage, and more than five pipes of the smaller diameter would actually be required. By Darcy's formula, which has been discussed in our columns lately, the actual number required would be about 5.6. 2. What head or pressure will it take to give the same volume in any number of smaller pipes as one of larger diameter? A.—Divide the volume delivered by the larger pipe by the number of smaller pipes; this will give the volume to be delivered by each of the smaller pipes. Then, to ascertain the head required, Darcy's formula may be used. See Mr. Cox's article upon the flow of air in pipes, in our issue of August 20th. For natural gas, the only change required would be for the density or weight of natural gas as compared with that of air. 3. In taking the minute pressure of a natural gas well which is closed at the mouth, the gage pressure is 100 pounds; is that the total pressure, or is there an absolute pressure in this case? A.—The pressure indicated by the gage is not absolute pressure. To the pressure indicated by the gage, the pressure of the atmosphere, usually called 15 pounds, is to be added, and the total will be the absolute pressure. 4. There are two gas wells of the same pressure, 100 pounds, and the same volume; one well is flowing alone into a 10-inch line, at a line pressure of 100 pounds; and then the other well is turned into the same line. What effect will this have on the pressure and volume in the line? A.—This question we cannot undertake to answer. The volume conveyed by the line would, of course, be increased, but would not be doubled. The pressure in the main would be increased, which would mean an increased back pressure and a retarded flow for each well. The actual effect would depend largely upon data not given, such as the length and diameters of the several pipes.

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# Business Specials.

**Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.**

Gear wheels, gear cutting., Grant; see page 14.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Presses and dies for bar and sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

Just Issued—Catalog No. 8. Mailed free. Clayton Air Compressor Works, 28 Cortlandt st., New York.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."

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## The Board of Visitors' Report on the Naval Academy.

We are not informed as to the personnel of the Board of Visitors which made a report recently upon the Annapolis Naval Academy; but that the board was fully alive to the requirements of the situation, and grimly determined that it should be no fault of theirs if the cadets failed to be made thoroughly efficient officers, is abundantly shown by the recommendations made, among which are the building of two *sailing* practice vessels for the use of the cadets; which is much the same as though an army board should recommend that infantry soldiers who must do their fighting with modern small caliber magazine guns should be supplied with bows and arrows for practice.

The board especially distinguishes itself, however, near the conclusion of its report when it says:

"We have noticed, with some surprise, that the officers and cadets of the academy do not salute the colors by removing their caps, but simply touch them after a formal fashion, apparently modeled on foreign customs. Ladies are also saluted in the same way, and not by uncovering the head. These practices are prescribed by orders. Believing that any marked departure from recognized military and social customs and manners is unwise, the board recommends, first, that the National colors be saluted by uncovering the head; second, that ladies be recognized in the manner usual among gentlemen. It is obvious that a military salute is entirely inappropriate when rendered to a lady,

who cannot hold military rank nor return the salute in the same manner."

In view of the fact that those in charge of the academy have allowed such a frightfully demoralizing lapse from correct practice regarding caps, we are totally unable to see how the board can consistently say, as it does in this same report, "that the excellent condition of affairs at the United States Naval Academy reflects the greatest credit upon the executive capacity of the Superintendent, of the Commandant of Cadets, and of the corps of officers in general." In other words, practices have been allowed to prevail which might easily cause the thoroughly trained officers of a foreign navy to decline to recognize our naval officers as gentlemen, and refuse to fight them at a time when it might be vitally important that a fight should take place, and yet this practice is condoned.

The general impression is that naval engineers think the Annapolis Academy might be shaken up a little with advantage to the Navy, and this report makes us wish that such a Board of Visitors could be composed of men who recognize today's conditions of naval science. Its report would be refreshing, if it ever saw the light of day.

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## Drill Jigs in England.

"The Engineer," of London, is publishing some rather quaint articles on matters connected with shop practice. It treated recently of what we call drill jigs, and we extract as follows:

"The copy is probably more frequently and advantageously employed for drilling than for any other operation. The forms it takes for this purpose are exceedingly numerous; we will merely indicate their general nature. The drilling copy consists essentially of a plate or plates having holes bushed with hard steel arranged at definite distances from one another. The simplest jig consists of a single plate with two bushed holes in it; the application is limited; more usually there are two somewhat similar plates and sides, the space between them forming a box which is adapted to receive either a rough casting or forging, or a partially machined article. This box copy may become further complicated by having several drilling holes in each of its sides, and perhaps rectangular or other shaped holes, also bushed with hardened steel, for regulating a slotting tool. The size and the cost may become very considerable. Occasionally drilling copies are used in places inaccessible to a machine, and the work has to be done by a hand automatic brace. In this case, as a rule, the drilling post forms part of the copy, the centers being accurately placed so that the drill works squarely through the hole. In all cases of drilling with copy a twist drill should be used by preference; failing that, of course, the drill used must have an accurately cylindrical part to fit the bushed hole. A rhymer should, without exception, follow the drill if fine work is desired. The manufacture of drill copies requires a considerable amount of skill and care. The method adopted as a rule is to drill the holes in the body of the copy as accurately in position as possible. Plug gages are then placed in these holes, and the distance between them carefully measured. Correction is generally required, and this is made by boring holes out a size larger, making the necessary correction. This may have to be repeated till exact accuracy is obtained. Bushes of steel are then turned to suit these holes, their exteriors and interiors being exactly concentric. The inner hole is made at first a slight fraction less than the size of the drill it is to suit. These bushes are then hardened, and the bore ground out to the exact size required. They are then driven firmly into their position in the copy. Eccentric bushes are occasionally used to facilitate the adjustment of the distance apart, but do not appear to be much approved. Occasionally an independent bush of a smaller diameter is used for insertion in a larger bush to secure concentricity of two holes."

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## Literary Notes.

POWER LOCOMOTION ON THE HIGHWAY. A Guide to the Literature Relating to Traction Engines and Other Power-Driven Carriages for Highways.

This is a work evidently of careful and thorough research and patient compilation, by Rhys Jenkins, Memb. Inst. Mech. Eng. It is probable that very little that is of value relating to the subject, and published prior to the end of 1895, has escaped Mr. Jenkins, and it is surprising to find so much that has been published on what we generally regard as an entirely new development. Those who have to do with motor carriages of any kind, and who would have at hand a convenient directory to the literature of the subject, should get the book, which is in the form of a pamphlet, and is published in London by Wm. Cato, Ltd., 32 Bouverie street, E. C. Price 2s. 6d.

The National Association of Manufacturers has issued a Hand Book which sets forth in condensed form the objects of the association and something of its plans for accomplishing those objects. Full lists of officers and members are given. It can be obtained by addressing the association at 1751 North Fourth street, Philadelphia.

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Some time ago, at the Pittsburg Testing Laboratory, a commission appointed for the purpose made a test of the strength of two lots of bicycle frames. There were six frames in each lot—one of these lots being made by the E. C. Stearns Company, Syracuse, N. Y., of steel; the other by the St. Louis Refrigerator & Wooden Gutter Company, of an alloy of aluminum called "Lu-mi-num." The tests showed that the steel frames were far superior in strength, but it was claimed by the "Lu-mi-num" people that the test was unfair, because, as alleged, the steel frames were not the regular product of the Stearns Company. In view of this, the Stearns Company offer to demonstrate by tests that American "marketable steel tubing" is at least as strong, weight for weight, as "Lu-mi-num."

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The file-making industry in England seems to be in an interesting condition at the present time. As an evidence that the long-lived superstition that files can be better made by hand than by machine is now dead, "The Engineer," London, states that a department of the British Government has placed contracts with several Sheffield firms, and in the specifications it is expressly stipulated that the files are to be machine-cut. Machinery seems now to have so taken possession of the file-makers that the orders given out for that line of machinery exceed the capacity of the shops to supply. Germany is now putting file-cutting machines into Sheffield, and at the same time German file manufacturers are buying file-grinding machines and chisel sharpeners in Sheffield.

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# Commercial Review.

NEW YORK, SATURDAY EVENING, OCT. 17TH.

IRON WORKING MACHINERY.

The machine tool market, from information obtainable in this business center, is characterized by the same features ascribed to it a month ago, but standing out with, perhaps, increased distinctness. That is, the establishments who then were experiencing a better trade report this month continued improvement, while those who then felt that business was not on the up grade generally find that it is now practically stationary or is falling off still more.

It is the domestic trade to which we have reference at present. The export trade is spoken of in high terms by about all who engage in it, and this serves as a rose-colored glass through which sellers can view the market in general. If we get down to cold, hard facts about the business which is confined wholly to this country, we have to acknowledge that there is not much to boast of; though even in this, improvement is reported by some houses.

"SEPTEMBER WAS THE BEST MONTH WE EVER HAD,"

is the experience of a certain concern domiciled in New England. It was principally owing, however, to foreign orders, with one large contract at home, and indicated no real increase in demand in this country. It is said that the market is without stability, that the orders which are

(Continued on page 37.)

# Help Wanted.

**Situation and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.**

**TO SUBSCRIBERS**

**whose names appear on our subscription list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.**

Help Wanted—Good pay for leisure hours. Address Geo. W. Lord, Philadelphia, Pa.

Tool and die maker wants a situation. Address J. Vesl-ge, 55 Lynch street, Brooklyn, N. Y.

Wanted—A mechanical position by a young man of technical education. Box 107, AM. MACHINIST.

Wanted—Position by an experienced layer out in boiler works; married. Box 106, AM. MACHINIST.

Experienced mechanical draftsman wants position; best references. Box 110, AMER. MACHINIST.

Experienced man on design, construction, erection and repairs of coal mine machinery and locomotives wants work. Address box 93, AM. MACH.

An erecting engineer and floor man wants position; would take a position as stationary engineer; best of references. Box 95, AMERICAN MACHINIST.

Position wanted by machine draftsman of ability and skill; is capable to take charge of small drawing room, and can act as book or time-keeper. Box 105, AMERICAN MACHINIST.

A mechanical engineer with considerable experience in designing metal-working machinery and tools would like a position in vicinity of Chicago. Box 102, AMERICAN MACHINIST.

Competent mechanical engineer, A1 constructor, owner of valuable inventions, would like position with some r-liable concern. Address. Editor Kansas City Presse, Kansas City, Mo.

Practical mechanic, experienced machinist and draftsman, well up in devising tools and systematizing methods for doing work accurate at the lowest cost, desires to change. Box 100, AM. MACH.

Experienced mechanical draftsman, 25 years of age, graduate of a technical college, with 5 years' experience in designing machinery, wants position. J. S., care German Technical Society, Phila., Pa.

Young M. E. (25), tech grad., capable draftsman and designer, exp. on pumps and general machy., open for engagement Nov. 1. Salary moderate at start. Refs. Address Box 104, AMER. MACHINIST.

Have 10 years' experience as foreman pattern maker on general machinery; can make close estimates and handle men to good advantage; would like to correspond with good firm wanting such a man. Box 109. AMERICAN MACHINIST.

Wanted—A tool maker of wide experience to take charge of tool room in a small shop; must be a first-class workman of good character and well recommended. Steady work with fair pay to the right man. Box 94, AMERICAN MACHINIST.

The advertiser wishes engagement with parties about to begin or already at the manufacture of steel balls; has many years experience as machinist, draftsman and designer; lately with ball making concern, and also valuable ideas of machines to reduce cost and improve quality. Box 103, AMERICAN MACHINIST.

Wanted—A thorough, practical mechanic to act as superintendent of a concern employing about 300 hands. Works consist of a machine shop and foundry making transmitting machinery principally. He must be a man of extensive ability and capable of taking entire charge of the mechanical part of the shop and formulating cost sheets, etc. None but an A No. 1 man with the requisite ability need apply. Box 101, AMERICAN MACHINIST.

A mechanical engineer from one of the best schools in the United States, who has had more than ten years experience with several of the leading United States firms in hydraulic machinery, steam engines, boilers and general mechanical engineering work, and who is at present superintendent of erecting for a London firm doing a large engi-eering business, desires to invest $12,000 in a reputable firm in which he could become engineer or manager. Box 108, AMERICAN MACHINIST.

▲ ▲ ▲

# Miscellaneous Wants.

**Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.**

Cheap 2d h'd lathes & planers. S.M.York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

We offer an exceedingly fine lot of first-class second-hand machinery, lathes, planers, shapers, drills, millers, screw machines, etc. Call, or get list 17 B. The Garvin Mach. Co., 440 Canal st., N.Y.

Wanted—A full lot of second-hand improved machine tools issuing from cycle manufacturer wishing to sell his machinery. Address prices and complete description of every machine to Mr. Pinet, 66 Cours de Vincennes, Paris, France.

Wanted—An Idea. Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co. Patent Attorneys, Washington, D. C., for their $1,800 prize offered to inventors.

(*Continued from page 36.*)

taken have to be specially worked up, and that one is at a loss to know where to turn in search of trade.

Some of the best signs are those now occasionally reported, of a little more inquiry, a little more willingness on the part of possible purchasers to come and talk business with people who have tools to sell. The sky has hardly yet begun to rain orders, but here and there clouds are gathering for a shower of them.

BEFORE THE SHOWER OF BUSINESS BREAKS OUT

how long a time after election will buyers be allowed, in which to get under cover? We hear that one company are preparing for the withdrawal of their present prices from quotation later than November 1st. But inquiry shows that the general state of the case is quite otherwise. As things now stand, one would be able to get tools for delivery pretty far in the future at pretty low rates. Just how many days of grace sellers will allow buyers after election in which to "cover their shorts" before prices are marked up, sellers seem hardly yet to have taken seriously into contemplation. Of course, the prices of some manufacturers change little or none from one year's end to another, and machinery prices are not wont to display the sensitiveness of those of the stock market, anyway.

WOOD WORKING MACHINERY

shows here and there a few orders and inquiries, but not such as, all things considered, to argue an especial change in the market for the better. A fairly good export trade is reported. One concern has received four or five orders which show notably wide distribution of trade. They came from China, England, San Domingo and Canada.

EXPORT TRADE NOTES.

The foreign trade of the United States in general merchandise shows, for September, remarkable improvement, as compared with the corresponding month of last year. Imports decreased 22½ per cent., while exports increased 45 per cent., breaking the record for September of any year. The increase in exports is due partly to a foreign shortage of wheat; and for the small imports our demoralized finances may be responsible.

A consular report from Peking states that American capitalists and railroad and shipbuilders seem to be taking an increasing interest in China. The American Trading Company, of New York, London, Yokohama and Shanghai, has, in addition to its regular business of importing and exporting, recently become the agent of the Cramp Shipbuilding Company and of the Union Iron Works. It represents, also, an American railroad syndicate, and has submitted bids for the building of a railroad between certain points, and of an electric railway at Shanghai. This same company has secured a concession to build a railroad in Corea, and has sold two ships for the Cramps, to the Japanese Government.

Manifests of export shipments from New York, given out through the Custom House during the week ending October 17th, show items of machinery summing up to $218,984, a heavier total than usual. Of this amount, about $147,000 worth was destined for Europe.

The reports show, in addition, that on a steamer which cleared October 7th, 4,800 steel rails, valued at $25,305, were shipped to Tampico; and consignments for Honolulu, on another vessel, included two locomotives, 2,140 steel rails and 3,250 kegs of nails. Four water wheels, valued at $1,250, were sent to Glasgow, and windmills to Amsterdam, Valparaiso and elsewhere.

IRON AND OTHER METALS.

The iron market has been rather quiet during the week. Inquiries are not numerous, and it seems to be simply a case of waiting through the short time longer that must intervene before the expected demand is created as a result of the election.

Among the mills which have resumed operations are the steel works of the Carnegie Company at Duquesne and Homestead. The Edgar Thompson Steel Works of the same company have started in, after a two weeks' shut-down, on their order from the Japanese Government for 10,000 tons of steel rails. The Scranton Steel Works of the Lackawanna Iron Company, the Braddock Wire Works of the Consolidated Steel and Wire Company, and the nail works, puddle and rolling mill of the Brooke Iron Company, at Birdsboro', Pa., are also beginning work.

The tin market, as a result of foreign speculation, has made a sharp advance. Shipments from the Straits, much lighter than expected, helped to bring this about.

Large sales by one producer have weakened the price of Lake Superior ingot copper.

According to advices received from Japan by Messrs. Robert Crooks & Co., shipments of refined Japanese antimony, which is the grade we quote, may, as a result of manipulations in that country, be

reduced or suspended for some time to come.

## Quotations.

NEW YORK, Monday, October 19th.

Iron—American pig, tidewater delivery:

| | |
|---|---|
| No. 1 foundry, Northern | $11 75 @ $13 00 |
| No. 2 foundry, Northern | 11 25 @ 12 00 |
| No. 2 plain, Northern | 10 50 @ 11 00 |
| Gray Forge | 10 50 @ 10 75 |
| No. 1 foundry, Southern | 11 50 @ 12 00 |
| No. 2 foundry, Southern | 11 00 @ 11 25 |
| No. 3 foundry, Southern | 10 50 @ 10 75 |
| No. 1 soft, Southern | 11 00 @ 11 25 |
| No. 2 soft, Southern | 10 75 @ 11 00 |
| Foundry forge, or No. 4 Southern | 10 25 @ 10 50 |

Bar Iron—Base—Mill price, in Carloads, on dock: common, 1.10 @ 1.15c.; refined, 1.20 @ 1.50c. Store prices: common, 1.40 @ 1.50c.; refined, 1.50 @ 1.80c.

Tool Steel—Ordinary sizes, standard quality, 5½ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—From store, 1.65 @ 1.75c. Special brands upward.

Cold Rolled Steel Shafting—Base size in carloads, about 2½c.; 2¾c. for smaller quantities from store.

Copper—Carload lots, Lake Superior ingot, 10⅝ @ 10¾c.; electrolytic, 10½c.; casting copper, 10¼ @ 10⅜c.

Pig Tin—For 5 and 10-ton lots, 13.10 @ 13.12½c., f. o. b.

Pig Lead—In carload lots, 2.72½ @ 2.75c., f. o. b.

Spelter—In carload lots, New York delivery, 3.70 @ 3.75c., f. o. b.

Antimony—Cookson's, 7.25c.; Hallett's, 6.37½c.; Japanese, 6.35 @ 6.4°c.

Lard Oil—Prime city, present make, commercial quality, in carload lots, 42 @ 44c.

▲ ▲ ▲

# Manufactures.

A new iron foundry will be built by Hopper & Scheel at Macon, Ga.

H. B. Cassell, Marietta, Pa., will place new machinery in his planing mill.

A new machine shop will be erected by Lee & Breumer at Wallaceburg, Ont.

The Georgia Marble Finishing Works, Canton, Ga., will install boiler, engine, etc.

The Penn Printing & Publishing Co., Philadelphia, Pa., will install new machinery.

The Farmville Mfg. Co., Farmville, Va., will place boilers, engines, elevators, etc.

Peters Bros., Guthsville, Pa., will start a shoe factory and will put in new machinery.

The Borough of Halifax, Pa., will build a large water works and install a line of machinery.

The Barnesboro Water Co., Barnesboro, Pa., intends to place new boiler, engine, pumps, etc.

Louis Bouchard has decided to build and operate a steam saw mill at Bay St. Paul, Que., Canada.

The Star Iron Company, 590 Craig street, Montreal, Que., have decided to increase their power.

The United States Electric Light Co., Washington, D. C., will increase their plant and place new machinery.

S. B. White & Son, Norfolk, Va., will erect a large agricultural implement works and install new machinery.

The American Laundry & Mfg. Co., Allegheny, Pa., will erect a large plant, and install new and improved machinery.

The Fulton Electric Light Co., of Fulton, Rock County, Wis., are going to enlarge their plant and put in a new 110-light arc dynamo.

The manager of the Le Roy Mining Co., Rossland, B. C., has decided to increase their boiler plant by two more, 125 H. P. each.

The Waltham watch factory, which had been running on half time all summer, commenced running 54 hours per week on the 15th.

The Gutta Percha Rubber Company, of Toronto, Canada, have decided to build a $9,500 addition to their factory on West Lodge avenue.

The U. S. Malleable Iron & Steel Co. has been organized at Chicago, Ill., with a capital of $100,000. Henry S. Blake is the chief promotor.

(Continued on page 39.)


Just Published. Two Reliable Books.

**"SHOP KINKS,"**

By ROBERT GRIMSHAW. Showing special Ways of Doing Work Better, more Cheaply, or more Rapidly than Usual.

**400 Pages, 225 Illustrations, $2.50.**

**"THE MODERN MACHINIST,"** By JOHN T. USHER, Machinist.

**320 Pages, 257 Illustrations, $2.50.**

☞ *Illustrated circulars of both sent free.*

NEARLY READY.

**"GAS, GASOLINE AND OIL ENGINES,"**

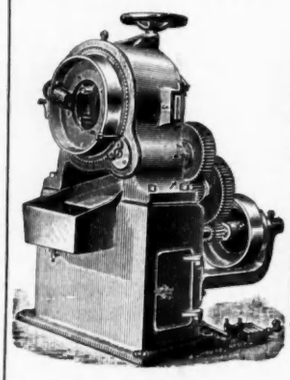
By GARDINER D. HISCOX, M. E.

**400 Pages. 200 Illustrations. Price, $2.50.**

This book treats comprehensively, and almost entirely of American makes of Gas, Gasoline and Oil Engines, with instructions for the care and management of the same.

Our Catalogues of Books for Machinists, Engineers, Electricians, etc., also sent free.

**NORMAN W. HENLEY & CO., Publishers,**
15 Beekman Street, NEW YORK.

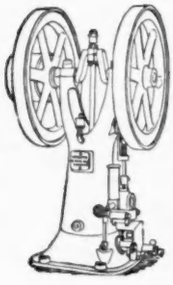


**CURTIS & CURTIS,**
66 CARDEN ST., BRIDGEPORT, CONN.
Pipe Cutting and Threading Machinery,
FOR HAND OR POWER.
RATCHET DRILLS, RATCHET DIE STOCKS AND MALLEABLE IRON PIPE VISES.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

**J. M. ALLEN, President.**
**WM. B. FRANKLIN, Vice-President.**
**F. B. ALLEN, Second Vice-President.**
**J. B. PIERCE, Secretary and Treasurer.**

**Vertical Milling Machine**
...AND...
**Drill Press Combined**
Send for Illustrated Circular "D," describing this and other specialties manufactured by
**R. M. CLOUGH, New Haven, Conn.**



**This beats Wind, Steam or Horse Power.**
We offer the
**WEBSTER** 2 1-2 ACTUAL HORSEPOWER
**GAS ENGINE**
For $150, less 10 per cent. discount for cash. Built on the interchangeable plan. Built of the best material. Made in lots of 100, therefore, we can make the price. Boxed for shipment, weight 800 pounds. Made for Gas or Gasoline.
☞ *Write for Special Catalog.*
**WEBSTER MFG. CO.**
1079 W. 15th St., CHICAGO.

**Columbia University**
**in the City of New York.**

SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
SCHOOL OF ENGINEERING,
SCHOOL OF ARCHITECTURE,
SCHOOL OF PURE SCIENCE.

Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded on application to the Secretary of the University.

**LATHES,**
FOOT POWER MACHINERY OF ALL KINDS,
Bicycle Repair Shop Tools, Vises, Forges, Screw Plates, Taps and Dies, Brazers, Wheel Truers, etc. Scroll Saws and Fancy Woods. Send 4c for Illustra'd Catalog.
THE WILKINSON CO., 83 Randolph Street, Chicago.

**LE BLOND LATHES**
12" 14" 16"
Pearl & Plum
CIN'TI. O.

P. BLAISDELL & CO.,
*Manufacturers of*
**Machinists' Tools**
London Agts.: C. W. BURTON, GRIFFITHS & Co.
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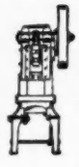
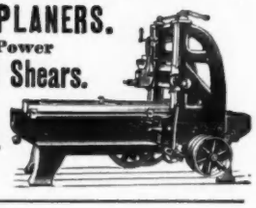


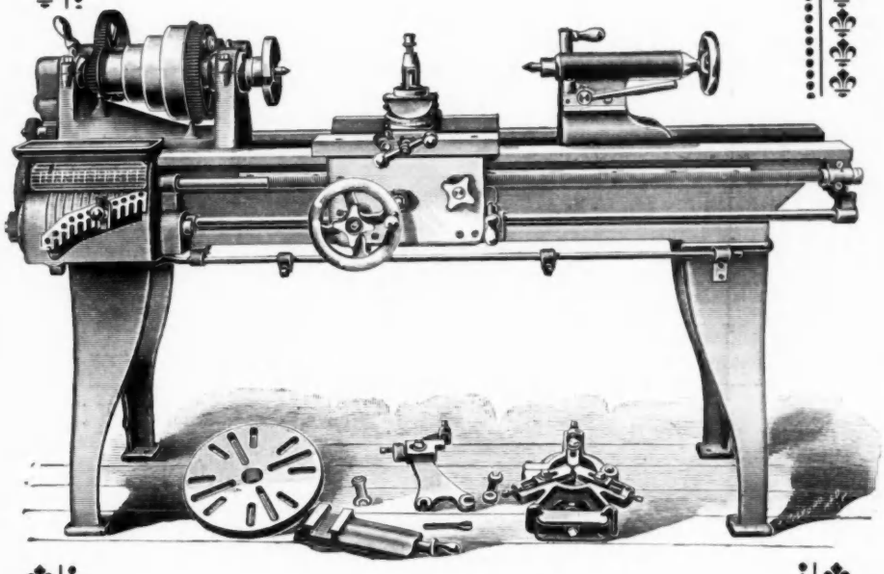
**Drop Hammers, Presses, Special Mach'y Dies.**
THE STILES & FLADD PRESS CO.,
WATERTOWN, N. Y.

**WHITCOMB PLANERS.**
Hand and Power
**Punches and Shears.**
Whitcomb Mfg. Co.
Worcester, Mass.



The best Bicycle Brazing Solder is the "Ball's Wire Spelter" made by Montgomery of N. Y. It is not the cheapest. The best '97 wheels will use it. Get samples, make up your mind and place your orders early.
Montgomery & Co.
105 Fulton St.
New York City.

This lathe combines the latest and best improvements.



14″ x 6′ Hendey-Norton Lathe

With Improved Automatic Stop.

**Automatic Stop**

It is durable, simple, indispensable. It will automatically stop the carriage in either direction. It is equally efficient whether feeding or thread-cutting, running up to a shoulder, boring to bottom of holes, or internal thread-cutting. No danger of spoiling either tool or work. It is a safeguard against accidents in either direction.

**Carriage**

The carriage reverses in apron; no slamming of countershaft. There is no comparison between this lathe and the old style or common lathe.

**Threads**

It has all threads in daily use with simple movement of lever.

**Feeds**

Has all feeds in daily use with simple movement of lever. Send for Circular.

The Hendey Machine Co.,
Torrington, Conn.

Agents for the Pacific Coast, Pacific Tool & Supply Co., San Francisco, Cal.

European Agents, { Chas Churchill & Co., London and Birmingham. Schuchardt & Schutte, Berlin and Vienna. Eugene Soller, Basel, Switzerland.


*(Continued from page 38.)*

A new firm, the Plumer Mfg. Co., of St. Louis, Mo., has been incorporated to manufacture machinery. Wm. S. Plumer is chairman.

Mr. J. C. Foster, Owen Sound, is preparing plans for a new chair factory at Chesley, Ont. A $20,000 company has been organized. J. M. Halliday, J. H. Elliot and John Krug are the principals.

Notice has been issued that Herr Emil Kolben has retired from connection with the business of the Maschinenfabrik Oerlikon at Zurich, Switzerland.

The Norcross Electric Light Co., of Janesville, Wis., intend to make an additional arc system. New shafting, clutch pulleys and dynamos will be put in.

An electric light plant is to be installed at New Kensington, Pa., for the purpose of lighting the town. About a 200-horse power plant is to be installed.

The tinware manufacturing company of Hill, Lloyd & Co., of Knoxville, Tenn., are enlarging their plant and contemplate installing new machinery.

Keystone Axle Co., Beaver Falls, Pa., will erect a number of heating furnaces, etc. Mr. Ed. E. Erikson, Conestoga Building, Pittsburgh, Pa., is the engineer in charge of their construction.

The Valley Water Company, of Emsworth, Allegheny County, Pa., has been organized by T. Lee Clark, Edw. S. Reynolds, A. C. Shaw and others, the object being to furnish that borough with water. A plant will be installed.

The Mackey Stained Glass Co., capital $2,000, headquarters Toronto, Ont., are applying for a charter to manufacture, buy, sell and deal in stained and other glass. C. E. Booth, S. E. Booth and A. A. Mackey are the proposed directors.

The Cummings Conduit Electrical Co., Detroit, Mich., are considering the starting of a branch factory for the manufacture of the Cummings Conduit Tube, at Toronto, Ont., Canada. Mr. G. T. Cummings has been in Toronto with that object in view.

Mr. E. S. Kelly, president of the Rubber Tire Wheel Co., Springfield, O., has bought the factory of the Star Slide Seat Co., of the same city, which firm failed some time ago, where he will commence the manufacture of a roller bearing for vehicles.

The Power City Lumber Co., of Niagara Falls, N. Y., whose plant was destroyed by fire a few weeks ago, are building a large lumber storehouse and planing mill. The mill is to be driven by electric motor and equipped with the most modern machinery.

It is understood that Miller Bros. & Co., of Pittsburgh, are preparing plans for a large steel plant to be erected in or near that city. No names can be obtained of those who are directly interested in the steel company, but the location is thought to be near McKeesport.

Mr. P. J. Loughrin, Sault Ste. Marie, Ontario, has decided to place two eighteen knot passenger and freight steamers on Lake Superior, having a capacity of 150 cabin and 200 deck or steerage passengers. These steamers are expected to be completed for the season of 1897.

T. Walsh, T. R. Deacon, N. Schnarr, Harry Wright, Harry Langford and C. E. Neads have applied, under a capital of $1,000,000, for incorporation as the Rainy River Gold Mining Co., head office, Rat Portage, Ont., to carry on the business of mining, reduction of ores and refining.

A company is being organized in Pittsburgh, Pa., with E. D. Estrada, of the Lewis Block, at the head, to put up a shop for erecting purposes. As yet no site has been selected, but this will probably be done in the near future. The necessary machinery to be installed will consist of punches, shears, bridge builders' machinery, etc.

The Hawk Bay Gold Mining Co., head office, Hamilton, Ont., have applied for incorporation to

operate in the Province of Ontario, exploring, mining, reducing, milling, shipping gold, silver, minerals, metals or ores, capital $150,000. John H. Tilden, H. N. Kitson, H. C. Beckett, F. C. Bruce, S. C. Mewburn, H. A. Wiley and H. C. McLean are the applicants.

J. Schinneller, McClintock building, Pittsburgh, Pa., will receive bids until the 26th inst. for two horizontal compound non-condensing duplex steam pumps, the pumps to be ready for active service 50 days after the awarding of the contract. Also for putting down a system of wells, laying a cast iron suction and discharge pipe, and connecting same to pumps and wells. Not less than 10 wells will be put down.

The Lagonda Cycle Co., Springfield, O., previously referred to, has been incorporated and the following directors have been chosen: Messrs. J. D. Hurd, D. P. Jefferies, H. Knife, I. W. Fry, C. H. Pierce, P. M. Cartmell, C. F. Griffith and J. M. Good. It has been decided to purchase the Bar & Knife shops at a cost of $135,000. The officers of the company are: President, C. E. Patrie; vice-president, I. W. Fry; secretary, J. M. Good, and treasurer, D. P. Jefferies. They will commence operations at once.

▲ ▲ ▲

## New Catalogs.

**There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.**

We have received the 1896 catalog of the Sterling Emery Wheel Co., Tiffin, O., which contains illustrations and descriptions of emery wheels, surface grinders, swing frame grinders, etc. The catalog is 6 x 9¼ inches.

The Wilbraham-Baker Blower Co., Philadelphia, Pa., have sent us a catalog devoted to the illustration and description of the Green Positive Rotary Pressure Blower which is manufactured by this company. The catalog is 6 x 9¼ inches.

John Adt & Son, New Haven, Conn., send us a catalog illustrating and describing wire straightening and cutting machines, foot presses, sprue cutters, riveting machines, etc., built by them. The catalog is large standard size, 9 x 12 inches.

Howard & Nichols Cycle Mfg. Co., Newark, N. J., have sent us a catalog devoted to the illustration and description of the Howard chainless bicycles. Engravings of the mechanism of these bicycles are given. The catalog is 4 x 8¾ inches.

We have received a small pamphlet containing information about the various phases of educational work carried on by the Franklin Institute, Philadelphia, Pa. Tuition fees are given and also a program of lectures for the coming season of 1896-97.

The American Gas Furnace Co., 80 Nassau street, New York, send us a special bicycle supplement to their illustrated catalog, which contains illustrations and descriptions of oven furnaces, brazing tables, gas furnaces, etc., used especially in the manufacture of bicycles. The catalog is 6¾ x 10 inches.

Institute for Home Study of Engineering, Cleveland, O., send us a descriptive catalog of that institution. Courses in steam engineering, mechanics and electricity are given at this institute The catalog contains outlines of these different courses, and also some letters from present and former students. The catalog is 6½ x 10 inches.

The Buffalo Forge Co., of Buffalo, N. Y., send us advance pages of their 1896 catalog, which is an excellent illustration of the growth of what not many years ago was a small industry into a large one. The growth of the fan blast heating and drying apparatus is especially noticeable. The catalog is very fully illustrated and contains 264 7½ x 9 inch pages. When completed the catalog is to contain 400 pages.


The Pratt & Whitney Co. HARTFORD, CONN., U.S.A.

...MAKERS OF...

Fine Machine Tools.

Complete Plants furnished for Bicycle, Typewriter, Gun and Sewing Machine Makers. Gauges and Small Tools for all Machine Work. Drop Hammers and Trimming Presses. Forging and Trimming Dies for all classes of work.

*England*—Buck & Hickman, 280 Whitechapel rd., London, E.; Chas. Churchill & Co., Ltd., London and Birmingham. *France*—F. G. Kreutzberger; Fenwick Freres & Co., 21 Rue Martel, Paris. *Chicago*—42 and 44 S. Clinton st. *Boston*—281 Franklin st. *New York*—123 Liberty st.

SHELL AND SOLID REAMERS,

WITH PAT. SPIRAL FLUTES.

Arbors, Mandrels, Taps, Dies, Screw Plates, Tap Wrenches, Bolt Cutters, Drilling Machines, Etc.

Wiley & Russell Mfg. Co., SEND FOR CATALOGUE.

GREENFIELD, MASS., U. S. A.

How To Run Electric, Simple and Compound Locomotives.

JOHN WILEY & SONS,

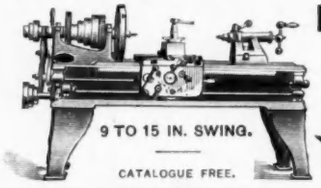
53 East 10th Street, NEW YORK CITY.

SECOND EDITION

REAGAN'S LOCOMOTIVES

12mo, Cloth, $2.00.

RIGHT UP TO DATE.

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SEBASTIAN LATHE CO.,

117 and 119 CULVERT ST., CINCINNATI, OHIO.

DYER & DRISCOLL,

PATENT SOLICITORS, 36 WALL ST., N.Y.

Have done all my patent soliciting work, both for this and foreign countries, continously for the past fourteen years.

Thomas A. Edison

STAR LATHES

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Foot Power Screw Cutting, Automatic Cross Feed, 9 and 12" Swing.

Send for Catalog B.

Seneca Falls Mfg. Co.

687 Water St., Seneca Falls, N.Y.

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JENKINS BROS., 71 John Street, New York.

31 N. Canal St., Chicago. 117 N. 4th St., Philadelphia. 105 Milk St., Boston.

EMERY WHEELS

NORTON Emery Wheel Co.

Worcester, Mass.

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MODERN MACHINE TOOLS

Constructed from designs embodying all the late improvements in economy, manipulation, strength and accuracy.

BETTS MACHINE CO., Wilmington, Del., U.S.A.

**BAUSH & HARRIS MACHINE TOOL CO.** HOLYOKE, MASS.

MANUFACTURERS OF

**Patent Radial Drills**

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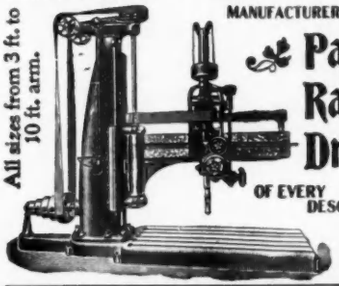

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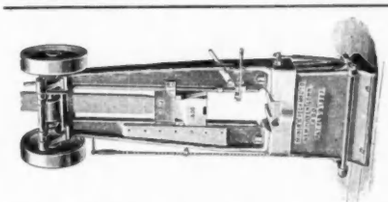

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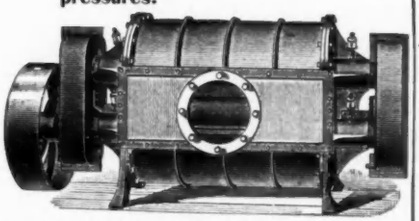

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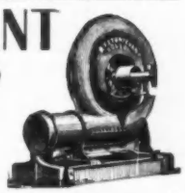

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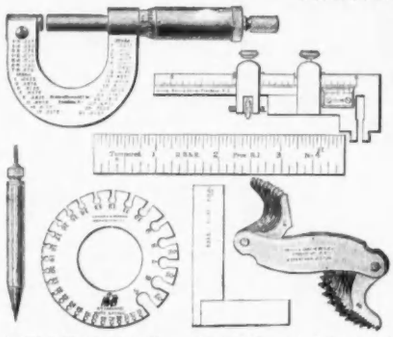

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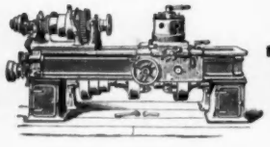

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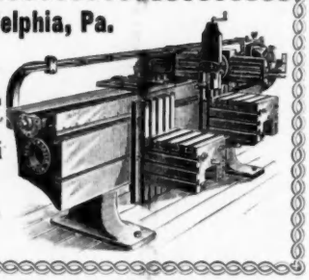

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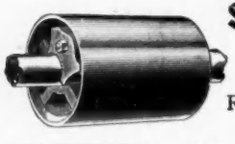

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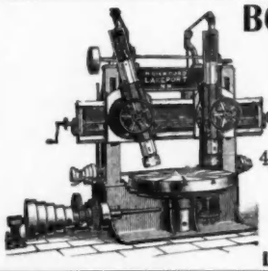

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